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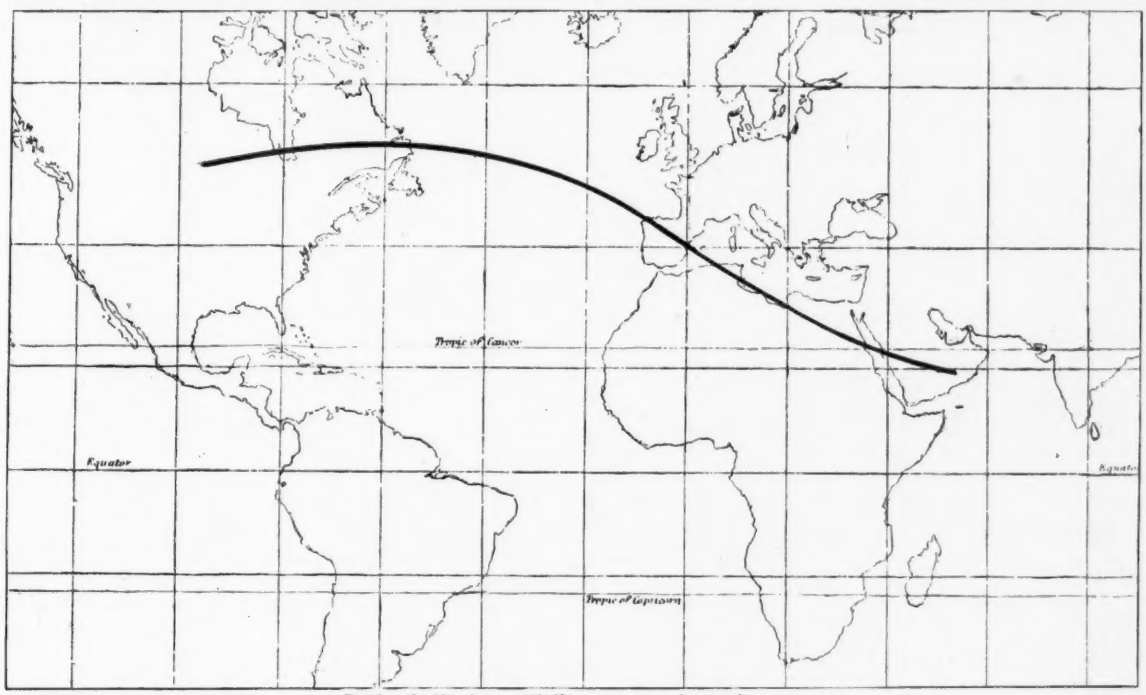
The Coming Total Eclipse.

By W. SHACKLETON, F.R.A.S.

THE extreme importance of making exhaustive observations during the total eclipse of the sun on August 30, 1905, is evident when we review the progress of astrophysics during the past decade, and bear in mind that the sun is the only star which can be examined in geometrical detail, whilst only the integrated effect of every other star can be studied. The elucidation of many stellar problems depend almost in their entirety on a more perfect understanding of the conditions existing on the sun. To give an example, the star γ Cygni presents a spectrum which, although akin to the Fraunhofer spectrum, differs markedly in detail, yet the outlying portions of the sun give, in the "flash," a spectrum bearing a close resemblance to that of the star. Again, the urgent need of making every preparation to collect useful data is apparent on looking into the future to see what opportunities will be available during another solar cycle for observations of our fiducial star under these special conditions. Enumerated below are the total eclipses of the sun during the next eleven years, with the locations of the shadow paths.

Date.	Duration.	Where visible.
1907—Jan. 14	2 mins.	Ural Mountains, Central Asia, China
1908—Jan. 3	4 ,,	Pacific Ocean; ends Isthmus of Panama
1908—Dec. 23	—	South Atlantic. (Annular eclipse, forming into a "Total" of short duration)
1909—June 17	1 ,,	Greenland, Arctic Regions, N. Siberia
1910—May 9	4 ,,	Antarctic Ocean, passes over Tasmania near end of eclipse
1911—April 28	5 ,,	Australasia, Pacific Ocean
1912—April 17	0·1 ,,	Spain. (Annular eclipse, forming into a "Total" of short duration)
1912—Oct. 10	1 ,,	Venezuela, Brazil, S. Atlantic
1914—Aug. 21	2 ,,	Greenland, Norway, Sweden, Russia, Persia
1916—Feb. 3	2 ,,	Pacific, Panama, Colombia, Venezuela, Atlantic, Azores



Path of Shadow. Eclipse, 1905, August 30.

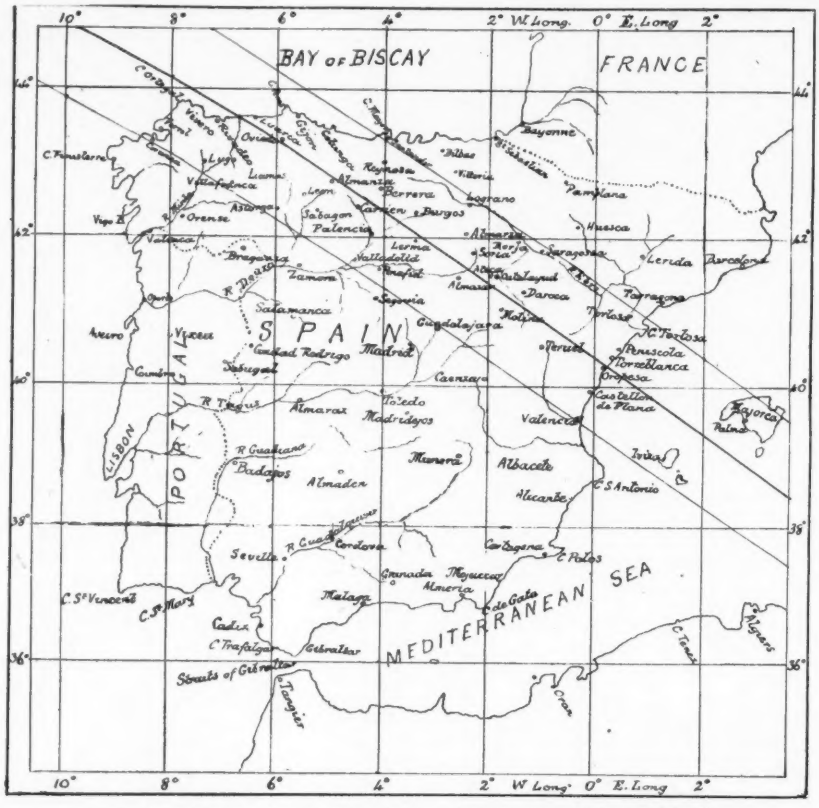
The total eclipse of the sun during the present year on August 30 possesses many advantages, in that it is almost at our own doors, is of long duration, and the most accessible for many years to come.

The shadow strikes the earth in Canada south-west of Hudson's Bay, where the eclipse begins at sunrise; it then leaves the American Continent near Domino Harbour, Labrador, crosses the Atlantic, and reaches Europe near C. Ortegal, in the N.W. of Spain, traverses over Spain, near Oviedo, Palencia, Burgos, Ateca, Calatayud, Castellon, thence across the Mediterranean to Algeria, Tunis, Tripoli, Egypt (near Assouan), and finally to Arabia, where the sun will be eclipsed at sunset. The width of the shadow varies slightly at different portions of the track, but it is, approximately, 120 miles.

Further particulars are as follows:—

—	Local Time. Beginning of Totality.	Duration.	Sun's Altitude.
		m. s.	
Domino Harbour ..	8.11 a.m.	2 38	27°
Oviedo	12.38 p.m. (noon)	3 40	56°
Palencia	12.48 p.m.	3 30	56°
Burgos	12·51 p.m.	3 35	56°
Ateca	1·4 p.m.	3 40	56°
Calatayud	1.4 p m.	3 40	56°
Castellon	1.21 p.m.	3 30	55°
Assouan (near) ..	4.36 p.m.	2 33	24°

On account of its proximity, Spain will be largely favoured as a site for making observations, and, in addition to parties from this country, further contingents may be expected from America. Burgos, already visited by some members of the British Astronomical Association after the eclipse of 1900, is of easy access, being served by the direct Paris Madrid rail, and can be reached from London in 32 hours, whilst Palencia can be reached almost as quickly, and has the advantage of being described as "healthy and cold." In consequence of the meagre accommodation (the greater part of which is already engaged at Burgos), a prolonged stay is undesirable, but San Sebastian or Biarritz may serve as a base for the former, and Santander for the latter place.



Spain, showing Central Eclipse Line, with North and South Limits.

Oviedo can be reached from Palencia in about 7½ hours, and is one of the few places in Spain with hotels described as "good."

Ateca and Calatayud are more difficult of access, as a journey to Madrid or Saragossa is involved, thence by the Madrid and Saragossa line.

The disadvantage of the Mediterranean coast is the great heat at this period of the year, but more favourable weather conditions are to be expected the further eastwards one proceeds. Castellon is one of the most promising places and can be reached from Valencia in less than two hours, or from Barcelona in six hours, whilst the journey from London to Barcelona can be made in thirty hours, or quicker than to Madrid.

A skeleton itinerary, with times of trains now in

operation to some of the above places, will give some indication of the time one should allow.

BURGOS AND PALENCIA.		ATECA AND CALATAYUD.	
London, 2.20 p.m.		London, 9.0 p.m.	
Paris, 10.7 p.m.	h. m.	Paris, 5 50 a.m.	
Paris, 10.36 p.m.	31 46	Paris, 12.18 p.m	
Burgos, 9.33 p.m.		Madrid, 2.25 p.m.	h. m.
Venta de Baños, 11.15 p.m.		Madrid, 2.50 p.m.	56 50
Venta de Baños, 1.46 a.m.		Ateca, 4.20 a.m.	
Palencia, 2.1 a.m.		Calatayud, 4.50 a.m.	
Santander, —		Saragossa, —	
London to Barcelona (*via* Lyons)	29¾ hrs.	Barcelona to Castellon (*via* Tarragona)	6¼ hrs.

The work to be attempted at any of the stations named has to be done in about 3½ minutes, hence to obtain useful results one should have a knowledge of some of the problems requiring further investigation or of new points to be attacked and arrange a programme accordingly.

The aim of all eclipse expeditions is to study those parts of the sun which are visible only during a total eclipse, in order to gain a further insight into the physical condition of the sun as a whole, and ultimately to bring this knowledge to bear on other cosmical bodies in general. The most obvious feature of a total eclipse is, of course, the Corona, and although it has been so repeatedly assailed, deeper and more perplexing problems have arisen in proportion to the assaults, and Professor Campbell concludes that "it is as enigmatical as ever."

Some of the more interesting points regarding the Corona are:—

Its visibility, photographically or visually, in the partial phases of the eclipse.

The extension of the coronal rays.

The differentiation of the part which shines mostly by reflected light from that which is self-luminous.

Its spectrum.

Other points, such as its connection with prominences, dark rifts, detailed structure, photometric value at varying distances from the Moon, rotation, brightness and wave lengths of its spectrum lines, cannot be fully considered in an article of this length.

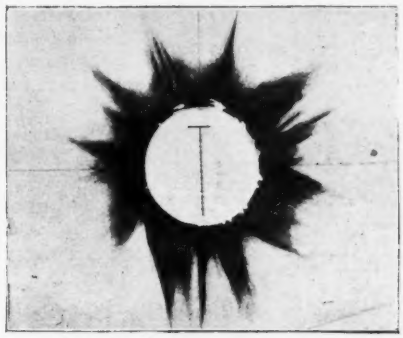
Small cameras can with advantage be employed in the solution of the first three points, but to meet with any measure of success the lens ratio of aperture to focal length requires to be large, partly in order that the exposure may be short enough to neglect equatorial following which will be unprovided for in the majority of cases with this class of instrument.

The most notable result as to coronal extension is the photograph obtained by Mrs. Maunder at the eclipse of 1898, with a lens ratio of *f*/6 exposing 20 seconds on a triple-coated Sandell plate, but as the conditions of the coming eclipse are different and the sun is approaching a maximum, long rays may not exist, or if present be no brighter than the sky background. However, it is in this direction that one must look for the recording of rays to the extent that the naked eye is able to perceive them. For prominences and the recording of detail of the lower parts of the Corona, a lens of long focal length, slow plates, and exposures of half a second or less are preferable, but as the scale of ordinary cameras is small, such records are best obtained with larger instruments, as the every-day camera is more profitably employed on other work.

Photographs should be taken several minutes before and after totality to ascertain when the Moon's limb can be discerned beyond the arc shown on the solar disc; when this point arrives it is evident we are seeing the Moon projected on the Corona as a background. It would be desirable to prevent the direct image of the crescent sun falling on the plate, but as this is varying, it is scarcely possible, except with a large image and clock movement, though one might try the effect of a screen such as is used in cloud photography, one of a greenish hue being preferable.

Such photographs will furnish useful data to determine the feasibility of observations of the Corona in annular eclipses or even without an eclipse.

In consequence of the varying brightness of the Corona at different distances from the sun's centre, it has usually been found necessary to compile a composite picture from many negatives to exhibit the detail of the coronal extensions from the sun's limb to their extremities, since any one exposure will only be correct for a particular brightness, some parts being over and others under-exposed. Now, the type of Corona to be expected is that usually shown at the maximum sun-spot period, and will in all probability be similar to those of 1882 and



Corona, 1893.

1893; Professor Turner has shown that in the case of the latter the law of luminosity of the Corona was:

$$\text{Brightness} \quad \text{varies as} \quad \left(\frac{\text{distance from}}{\text{sun's } \textit{centre}}\right)^{-6}$$

He has shown also that the same law represents the luminosity of the 1898 Corona, and probably it approaches near the truth for all the various types of Coronas, and is more satisfactory than that formulated by Professor Harkness in 1878, who gave the brightness varying simply as the inverse square from the *limb*, for if the Corona be largely made up of minute particles, other inverse powers of the distance in addition to the ordinary inverse square law of luminosity will enter into the equation.

Hence to obtain photographs of the Corona with the exposure correct for every part, it will be necessary to adopt a method similar to that employed by Buckhalter, and use a rotating disc immediately in front of the plate on which the image falls, with a templet cut out to give the exposure in accordance with the above law.

(*To be Continued.*)

Exhibition of Meteorological Instruments.

THE Council of the Royal Meteorological Society have arranged to hold, by permission of the President and Council of the Institution of Civil Engineers, at their house in Great George Street, Westminster, an exhibition of meteorological instruments from March 14 to 17 next. The exhibition will be chiefly devoted to recording instruments; but will also include new meteorological apparatus invented or first constructed since the Society's last exhibition, as well as photographs, drawings, and other objects possessing meteorological interest, or instruments of very early origin.

XUM

Rare Living Animals in London.

By P. L. SCLATER, D.Sc., F.R.S.

IV.—The Glossy Ibis.

THAT the "Glossy Ibis," formerly known to the gunners of the Eastern counties as the "Black Curlew," was much more abundant in the fens of Norfolk and Cambridgeshire in past years is certain, but whether it was ever a regular breeding inhabitant of those districts does not seem to have been clearly made out. In these days, however, the Glossy Ibis can only be classed as a not very infrequent straggler to the British Islands, mostly occurring in the eastern and southern counties. But it is a bird of wide range, being found in suitable localities all over Africa, Southern Asia, the Moluccas, and as far off as Eastern Australia, where it has lately been ascertained to nest more or less frequently.

The Glossy Ibis.

In Europe the principal strongholds of the Glossy Ibis are in the marshes of the Lower Danube, and the swamps of the Guadalquivir, in Southern Spain, in both of which localities it breeds in large communities in company with other water-birds. In the former district, near Belgrade, and extending into the valleys of the Theiss and the Save is an endless plain, covered with forests of reeds, which is a perfect paradise for fish-eating birds of all sorts. It is full of rivers and lakes, flooded meadows, and half-submerged forests of willows and alders, a combination well calculated to make bird-life easy, and secure from man's intrusion. In 1883 this district was visited by Mr. W. Eagle Clarke and a party of Ornithologists, who subsequently published an excellent account of their excursion in "The Ibis." In a breeding station on the Save they found an enormous colony of Herons of different species, Pigmy Cormorants, Spoonbills, and Glossy Ibises engaged in making their nests in the bushes amongst the reeds, and forming a most attractive spectacle. Similar accounts are given by those who have visited the breeding haunts of this bird on the Guadalquivir, in Southern Spain, in the more sequestered lakes of India and Ceylon, and even as far off as in Eastern Australia, where, as we are informed by Mr. A. J. Campbell, in his volume on the "Nests and Eggs of Australian Birds," the Glossy Ibis was first detected breeding in 1889. This Ibis is also found in the southern States of North America, but in South America it appears to be replaced by a closely-allied form, the White-faced Ibis, distinguished by a narrow white line on the front of the beak.

In the Zoological Society's Gardens the Glossy Ibis was formerly quite a rare bird, the first record of its presence there having been made in 1866. But in January, 1893, the Society purchased from a dealer seven young specimens of the closely-allied White-faced Ibis imported from Argentina, which at that time could not be distinguished from examples of the Glossy Ibis of the same age. These were placed in the Great Aviary, where they did well. In August of the same year they were joined by twelve specimens of the European Glossy Ibis, presented by the late Lord Lilford, who had received them along with other water-

birds from his correspondents at Seville. The South American and European cousins made friends at once, and formed a united flock, amongst which it was hardly possible to discriminate the two species, so much alike are they except in the height of the breeding season.

In the spring of 1895 the Ibises showed signs of breeding, and were to be seen carrying about sticks in their beaks. Many pairs were soon formed, without regard as to both sexes belonging to the same variety. The nests were placed on the summits of the stunted trees in the Great Aviary, formed of sticks, straw, moss, and other materials supplied to the birds by the keepers. The first brood of three young ones was hatched on June 19th of that year. Since that period the same process has been repeated every season, and though there have been many accidents and misadventures to these birds, which have a difficult task to hold their own amongst so many evilly-disposed neighbours, the flock of Glossy Ibises still exists, and the birds go on breeding, with more or less success, every year. It is impossible to tell the exact parentage of the different birds now in the Society's Gardens, but the greater number of them are probably hybrids between *Plegadis falcinellus* of Europe and *P. guarauna* of Argentina.

A new consignment of the European species has lately arrived, which, when the breeding-season of 1905 comes on, will, no doubt, give fresh vigour to this most interesting family.

Heredity.

By J. C. SHENSTONE, F.L.S.

II.

SPRENGEL, in his great work, led to the knowledge that forms of flowers exist solely for the purpose of securing the fertilisation of the seed. Those flowers which are inconspicuous and do not attract insects by their perfume or by their honey, as for instance most of the grasses, discharge clouds of pollen into the air, which is conveyed by the wind to other plants; but in the majority of cases flowers are specially constructed to attract insects in search of honey and of this pollen, as the yellow dust is now called. In their search they convey portions of the pollen from flower to flower, and thus the seeds of one plant are usually fertilised by pollen conveyed from another. Sprengel did not realise the full importance of the cross-fertilisation thus secured, but no botanist now doubts that cross-fertilisation is a profound necessity, and that the innumerable forms of flowers and their brilliant colours are due to their being constructed to attract the attention of insects. Sprengel, like many other great men, was born too soon.

Darwin's great work in establishing the theory of Evolution, and in demonstrating that we owe the innumerable forms of animal and vegetable life to a process of development, and to a process of "natural selection"—those individuals least suited to their environment disappearing as the result of the fierce competition constantly proceeding in nature—is too well known to need repetition here, but I should explain that whilst Chas. Darwin was elaborating his theory, and immediately afterwards, a mass of work was done by others which contributed to place the new development of knowledge upon a sure foundation. Not least among those who helped in this work was Nageli, who attacked the problems of life from quite a different direction, bringing a considerable training in physical enquiry to bear upon the study of the development of plants by the aid of the microscope.

If a very thin slice of the pith from a young shoot of elder be examined under the microscope, it will be seen to consist of a number of small bladders known to botanists as cells. When a cell is subjected to a temperature of 122 F. its contents shrink away from the outer skin, and can be discovered to consist mainly of a viscid granular substance. Nageli showed that this was true of the cells of the most lowly as well as the most highly developed plant and animal, for both of these are entirely composed of such bodies, and that everything living has grown from a single cell by a process of division, each cell becoming divided into two or more perfect cells, which are seen to divide again and again during the life of the tissue. Nageli also enriched the theory of evolution, as afterwards acknowledged by Chas. Darwin, by establishing the fact that there exist laws of variation in living things, which lead to their perfection, and also to their variation independently of the changes brought about by the struggle for existence. Thus at the end of the last century it was admitted that the essential basis of animal and vegetable life lies in the granular substance contained within the cell; that each animal and each plant is developed from a single cell now called the *germ-cell*; and that whilst the chemical and physical forces acting in living things are indistinguishable from the same forces when acting in dead matter, there exist indications of yet other laws of variation which lead to the perfection of living forms and to their differentiation. Finally, that the innumerable forms of plants and animals existing to-day are the outcome of natural selection; that these are due to the survival of those most suited to the changing conditions of life, and to the destruction of forms less able to hold their own in the struggle for existence.*

We are all familiar with the stages through which some members of the animal kingdom, *e.g.*, butterflies and moths, pass during their development into the perfect form. A caterpillar is hatched from an egg, this in due course is transformed into a chrysalis, from which the perfect butterfly or moth emerges, and the frog passes through the tadpole stage before arriving at complete development. Some classes of plants pass through similar stages, and it is held by most naturalists that the history of each individual recapitulates the history of its ancestry, and that if we traced the development of an animal or a plant from a single cell, or minute viscid body from which each individual is developed, we should discover the leading features of its ancestry.

After Darwin's theory had secured the support of men of science, Weismann impressed upon us the importance of the fact that all the characters, including the most minute peculiarity of bodily structure or mental disposition, must be transmitted from genera-

*It is contended by some botanists that species may have come into existence suddenly. The variations in both plants and animals, popularly known as sports, are known to all observers of nature. The varieity of clover with four leaflets instead of three, and human beings with an abnormal number of fingers or toes, serve as examples. It is contended that such variations, called by biologists mutations or discontinuous variations, may have given rise to new species. Gardeners and breeders of animals have taken advantage of such variations for producing cultivated varieties, but no variety obtained in this manner has so far proved capable of holding its own in its wild state.

tion to generation through the viscid contents of the germ-cells. Not only has this minute body concentrated within it the power of reproducing all the anatomical details, but it must also transmit the peculiar difference of temperament of animals, which has given to the cat and dog, for example, a disposition to scratch and bite one another from time immemorable. This conception of the germ-cell would lead us to regard all animal and vegetable life as, in a sense, immortal; for as every living thing contains within it the power of producing this germ-cell, which in its turn has the power of developing all the mental and anatomical characters of the individual from which it is derived, it may be argued that each living thing contains within it the possibility of immortality.

The next contribution to our modern views upon heredity was made by Francis Galton. It is clear that animals and plants all receive contributions towards the characters they inherit, not only from their two parents, but also from their four grand-parents, their eight great-grand-parents, and in fact any ancestor may contribute characters down through a long line of descendants, and hence that each individual living thing must have inherited its characters from many millions of ancestors. As the number of ancestors becomes doubled in each generation through which we carry our enquiry, a simple calculation will demonstrate the large number of ancestors from which the individual has descended. In ten generations the number exceeds two thousand, provided that there has been no inter-marrying, and these figures increase more rapidly the further back we carry our calculations. It is obvious that only a portion of any individual ancestor could be transmitted. Thus if one parent has dark hair and the other flaxen hair, the child could not have both flaxen hair and dark hair; he must inherit either flaxen hair from one parent or dark hair from the other parent, or he must inherit an intermediate shade, receiving contributions from both parents. The child of a very tall father and a very short mother will either be tall, short, or of some intermediate height; he could not possibly inherit the characters of both parents in this respect. When we realise the vast number of ancestors from each of whom individuals may inherit characters, of those contributed by all the rest, we see how complicated the subject of heredity becomes. But the actual contributions from ancestors seem to diminish as we go backwards, for the contributions of the two parents, one would suppose, must equal those of the four grand-parents, of the eight great-grand-parents, and so on, since all the contributions combine into one individual. It is therefore convenient to confine the enquiry to the few later generations from which most of the characters have been received. Galton has endeavoured to do this and to construct a law of heredity upon these considerations. For this purpose he supposes that each individual receives half his characters from his two parents, one quarter from his four grand-parents, and one-eighth from his more remote ancestors. This assumption has received some support from materials found in the stock of the Basset hounds, started some years previously by Sir Everett Millais.

Galton's hypothesis refers more particularly to those characters which blend in the offspring. There are however, many characters which will not blend. The coat colour of horses affords a good example of these. One seldom sees horses whose coat colour cannot be referred to one of the colours known as bay, chestnut, grey, and so on; the eye colour in man affords another example; we see brown eyes, blue eyes, hazel eyes, etc., but we seldom see tints which cannot at once be referred to some one or other well defined tints. When the eye colour of the two parents differs in tint, the child is stated to inherit this character from one parent only, or from some one more remote ancestor. A remarkable series of experiments, published in 1865, by Gregor Mendel, dealing more particularly with these characters which do not blend in the offspring, have lately been the subject of much animated discussion.

Gregor Johann Mendel, born in Odran, in Austrian Silesia, was the son of well-to-do peasants. In 1847 he was ordained priest, he studied physics and natural science in Vienna, and returning to the cloister became a teacher in the realschule at Brun. The importance of his experiments, which were carried out in the garden of his convent, were quite overlooked until recently, when they were simultaneously rediscovered by several investigators. The circumstances connected with Mendel's researches appear to be peculiarly like those of Sprengel's discovery of the fertilisation of plants by the aid of insects, except that, fortunately, Mendel does not appear to have allowed his enthusiasm for science to interfere with his duties to his Church. Professor de Vries called attention to Mendel's remarkable memoir in 1890, and Mendel's observations have since been confirmed by other workers.

These investigations consisted in experiments made by crossing varieties of plants differing from one another in some important pair of characters, and resulted in progeny being obtained which inherited those characters according to fixed numerical rules; thus Mendel's experiments give us ground for hoping to discover the laws which control the forces of heredity. He made a large number of experiments on the garden peas, selecting varieties having pairs of characters suited to his purpose. If the reader will observe the seed-peas sold at seed-shops, he will notice that some are almost round with smooth coats, whilst others are very much wrinkled; he will also discover, upon splitting these seed-peas open, that the substance of some of them is decidedly green in colour, whilst in others it is bright-yellow. If he carries his enquiries further and grows plants from these seeds, he will find that some produce very inflated pods, whilst others produce pods which do not exhibit this character. It was because the common pea lent itself to Mendel's purpose, by affording many such pairs of characters, that he experimented upon it. His results were, in brief, after crossing many plants differing in some one pair of characters, in every case all the offspring could be referred to one or the other of the parent forms. This character to which the offspring of the first cross could be referred, he called the dominant character, and that which disappeared he called the recessive character. From the seed obtained from a first experiment he made a second, when he found that only twenty-five per cent. of the offspring from this second cross retained the dominant character; the remaining seventy-five per cent. having reverted to the recessive character; but he also found that the offspring which remained dominant in this second experiment *continued dominant in all subsequent generations*. Carrying his experiments a stage further with the seventy-five per cent., which had reverted to the recessive character, he found *that one-*

third of these remained recessive in all subsequent generations. And still continuing his experiments with the remaining fifty per cent., he found they gave recessive and dominant characters in the same proportions as in earlier generations.

In recent years many sets of experiments have been made to test Mendel's results, and Mr. W. Bateson has initiated a movement for the thorough further investigation of the subject experimentally, whilst, on the other hand, a school of biologists led by Professor Weldon, who have been applying the mathematical methods for solving the difficult problems of heredity, contend that the results obtained by Mendel do not accord with the mathematical laws as worked out by those following the lines of enquiry laid down by Galton. These differences in the results obtained by the two schools of biologists are giving rise to much controversy, but the history of science is rich in instances in which investigations giving apparently discordant results have led up to important additions to our knowledge. We have very good ground for hoping that, in the near future, very important further steps may be made in this direction for placing our knowledge of this important subject upon a scientific basis.

A problem of great interest which has provoked much discussion in recent years, is the question whether characters which have been acquired during the life of an individual are transmitted to its offspring. Darwin under the title of "Use and Disease," admits it as possible that the power of flight possessed by wild ducks may have been lost by tame ducks in consequence of disuse. In more recent years, Weismann has convinced himself that characters of this nature are not transmitted to the offspring. The blacksmith's arms become abnormally developed in the exercise of his calling; but no instance has been recorded in which blacksmiths' children were endowed with any special development of the muscles of their arms. The feet of Chinese women have been artificially distorted for ages, but they will still develop to natural proportions if permitted to do so. The loss of power of flight by tame ducks is best explained by the survival of those varieties with small powers of flight, under artificial conditions, being favoured by selection, whilst in the wild state the birds with great power of flight can best escape from their enemies. There is, however, another description of acquired character, which cannot be finally dismissed without further investigation. Some keepers and others experienced in training dogs for sport are convinced that the offspring of dogs which have been trained can invariably be broken in with much less trouble than the offspring of dogs from equally good stock which had been kept as domestic pets. A naturalist friend of mine who has kept various species of mice in confinement, assures me that whilst the progeny of white mice, whose ancestors have been kept for many generations as pets, in their earliest stage of growth show little fear of man—though we have no evidence of this characteristic having been favoured by selection—the offspring of the field-mouse, as soon as it can run, will scamper off on the approach of man. It is difficult to explain the peculiar habits of the cuckoo, unless they were acquired at some early period. The solitary wasp, which, like the cuckoo, never knows its parents, constructs a nest or cell in which it stores small caterpillars, injured but not killed, and hangs its eggs well out of risk of damage by the caterpillars, so that when the egg hatches the grub may find a plentiful store of fresh meat at hand. Many similar examples occur amongst fishes and insects. And until we can satisfy ourselves that these animals, fishes, and insects have some means of communicating with one another in mature life, or until it has been shown how such habits can arise without having been acquired, it is difficult to dismiss altogether the inheritance of acquired characters as impossible. Professor Herring, in an address upon heredity, delivered at the Imperial Academy of Sciences, Vienna, May 30th, 1870, suggested that as it is noteworthy that every act of our daily lives is due to unconscious memory, the power of memory may be the property of all organised matter, and that it may be transmitted from one generation to another through the germ-cell. This problem should not be beyond the reach of experiment, and if established might not only explain these obscure phenomena, but many others, both in the vegetable and animal kingdom: the power possessed by roots of penetrating the soil, avoiding light and air; the habit of some flowers of poking their seed-vessels into crevices in rocks and walls or burying them in the ground; the habit of sun-dews of closing their glandular hairs when stimulated by insect prey; periodicity, so frequent in animals and plants, as, for instance, the opening of those flowers which require day-flying insects to convey their pollen from plant to plant in the morning, whilst those flowers which rely upon night-flying insects for this duty open in the evening; and many other similar phenomena. The possibility that the transmission of the power of memory from one generation to another may play some part in transmitting such habits should not be entirely dismissed until it has been tested by careful experimental investigation.

Other phenomena of heredity not having advanced since the pre-Darwinian days, we must proceed to consider the possible application of a greater knowledge of the subject to the benefit of mankind. The application of well-established rules by the breeder of animals and by horticulturists is too obvious to dwell upon. Already racing and draught horses, fat cattle, sporting dogs, brilliant flowers, luscious fruit, and other things demanded by men are attained by the practical man almost to order; nevertheless, an exact knowledge of the laws underlying these industries might bring about as great a revolution as that which has been accomplished in fields of activity by the application of principles of physical science. But a question of even greater importance remains. What effect will a more exact knowledge of these laws have upon the human race itself?

At a recent meeting of the Sociological Society, allusions were made to the "false social standard" and to the indiscriminate attachments by men and women. It was suggested that a wider diffusion of a knowledge of the laws of heredity "would bring influence to bear upon marriages." Sound knowledge of the scientific laws underlying the phenomena of nature has had a most beneficent effect upon humanity in the past, and any addition to our knowledge will undoubtedly be valuable in the future, yet the sober student must find some difficulty in foretelling the direct effect of an extension of our knowledge of heredity upon the races of men. It is difficult to conceive by what system of exact measurements we could estimate the subtle and innumerable physical and mental traits which go to the making of a Napoleon, a Bismarck, or a Darwin.

Sir Edwin Arnold foretold the destiny of the Japanese race, at a time when they were regarded by

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Western people as a nation of intelligent and artistic children; but I fail to see how a scientific knowledge would enable us to derive accurate and numerical value from the subtle and remarkable qualities which have enabled Japan in a few years to raise itself to the level of a great Western nation, nor how we could set about the business of producing such a race. Without some quantitative method of measuring all the qualities which make the higher type of man, the direct application of scientific methods would be impossible.

Creation of Species.

TO THE EDITORS OF "KNOWLEDGE."

DEAR SIRS,—In Mr. Shenstone's interesting article on Heredity, on p. 17, he writes:—"The belief that every form of animal plant owes its existence to a special act of creation and . . . accorded with the tenets of the Churches."

The last few words are somewhat vague, but the only theological dogmas bearing on the subject are those held by the opposing schools of Traducianism and Creationism. The latter, it is true, held that every soul (*i.e.*, every separate life above that of the vegetable world) is separately created; this is, however, by no means inconsistent with any theory of heredity on evolution. While the more widely held theory of Traducianism—that every life is derived from another life—naturally leads to some form of evolution, and would cover the most violent deductions therefrom.

The writer's further allusions show that he is referring to popular prejudice or superstition; but it is hardly possible to style this the "tenets of the Churches."

Yours very faithfully,

Verwood, Dorset, January 14, 1905. HERBERT DRAKE.

Lighthouse Illumination.

HELIGOLAND LIGHTHOUSE carries one of the greatest searchlights actually in use, and its candle power is placed at the rather incomprehensible figure of 30,000,000. Such a figure conveys very little, but the Schuckert Company of Nuremburg, which built the light, have constructed a still larger one, for which they claim an illuminating capacity equal to 316,000,000 candles. If it were possible to set this giant on a tower three hundred feet high its rays could easily be detected 80 miles away, and those who cherish fancies about light telephony can even imagine that conversations could be made audible by it at such distances. The searchlight has a diameter of 6 ft. 6 ins., which would be a large size for a church clock, and it is built with an iris shutter, such as some modern cameras have. The leaves of the shutter slide within a fixed diaphragm in the axis of the ray of light, and the electrical control is such as to enable the shutter to govern the movement of the beam of light in horizontal or vertical directions. By the side of these the flash light lately installed at St. Catharine's Point seems but an insignificant beacon, for it is only of 15,000,000 candle power. But it is five times as powerful as the light it replaces, and it is believed that in clear weather its flicker will be perceptible from the French coast. The lens has been made in Birmingham. The revolving portion of the mechanism, instead of being mounted on rollers as hitherto, floats in a big trough of mercury, and rotation is easily and accurately brought about by a clockwork mechanism of a kind not unlike that in old eight-day clocks. The electrical energy of the light is derived from the same magneto-electric generators which have been working for 17 years now without a breakdown.

Why "Common"?

By F. G. AFLALO, F.R.G.S., F.Z.S.

THE careless use of the word "common" is apparent in our every-day language. To take a familiar instance, we call "common sense" that which is about the rarest kind of sense known. The strongest objection, however, to which the word lays itself open is in zoological nomenclature, in which it is in constant use as a trivial specific distinction: thus Common Seal, Common Gull, &c.

The two Latin equivalents, *communis*, *vulgaris*, are, if anything, yet more reprehensible, not only by reason of their greater scientific weight, but because their cosmopolitan currency tends to aggravate a geographical fallacy that will presently be indicated. I am not Latin scholar enough to differentiate the shades of meaning between the two in their zoological application to certain species of animals. In another meaning, the *sensum communem* of Phaedrus, or the *vulgaris sensus* of Cicero, the *nuances* are obvious, and can be respectively rendered, I imagine, by common sense and the feelings common to humanity. But as zoological terms I shall, subject to correction, regard them as identical, and therefore open to the same criticisms.

It is proposed, for the sake of brevity, to draw examples that illustrate the drawbacks of these terms from British vertebrate forms only; it will be easy for anyone wishing to do so to extend the inquiry to both invertebrate and exotic species.

Let us have done with the two Latin equivalents first. As regards British vertebrates, *communis* is, in the majority of systems, used of only four forms: *Coturnix*, *Grus*, *Phocæna*, and *Turtur*. As regards *Grus*, which, however common it may once have been in these islands, cannot by any stretch of the imagination be so described at the present day, it is true that Mr. Harting has adopted *cinerea* as a more satisfactory specific name for a bird rarely seen here to-day outside of menageries, though it bred freely a couple of centuries ago. Yet it is a pity that he should not also have found an equally satisfactory substitute in the case of *Coturnix*, for quails are nowadays so rare, thanks in great measure to wasteful slaughter on the Mediterranean littoral, that every occurrence is considered worth recording in sporting and ornithological journals. As to the turtle-dove, it would be interesting to know in what part of the country it can accurately be indicated as common. The marine mammal, the fourth of these, will be dealt with later.

The other Latin specific prefix is in much more general use, and nearly thirty British vertebrate forms, or approximately two-thirds, are fishes. The full list of British beasts, birds, amphibians, and fishes distinguished in many writers as *vulgaris* are as follow:—Mammals: *Sorex*, *Lutra*, *Mustela*, *Sciurus*. Birds: *Sturnus*, *Vanellus*. Amphibian: *Molge*. Fishes: *Acanthias*, *Anguilla*, *Barbus*, *Belone*, *Box*, *Conger*, *Dentex*, *Galeus*, *Hippoglossus*, *Leuciscus*, *Liparis*, *Lota*, *Merluccius*, *Molva*, *Mustelus*, *Pagrus*, *Solea*, *Thymallus*, *Tinca*.

The use of the word *vulgaris* in respect of types like the otter, squirrel, starling, or lapwing, which are the only species of their genus known in these islands, cannot be reasonably objected to like the similar use of the English equivalent "common," for the Latin designation is used in all countries subscribing to what we may term the international scientific union, and is there admissible so long as this particular species is, generally speaking, commoner than the rest. Of the lapwing, it is to be observed that Mr. Harting and most modern authorities

substitute *cristatus*, a far better distinction based on a familiar character of the bird. Although, as has been said, our criticism must not be strained in respect of the cosmopolitan *vulgaris*, it may be permissible to point out that the objection would, so far as only British seas are concerned, equally apply to all but four of the twenty-nine fishes. *Leuciscus*, *Liparis*, *Pagrus*, and *Solea* alone have more than one British species, and of these it is doubtful whether the dace is more abundant over any considerable region than the roach or minnow, while the sole—also known to naturalists, though not to those who sell and buy fish, as the "common" sole—is not only yearly growing rarer from the operations of the trawler, but is practically absent from the more northern waters of Europe, being replaced on the Scotch coast by the very inferior lemon-sole (*S. lascaris*). Professor McIntosh once attempted to acclimatise the true sole on the east coast of that country, but with what success is not accurately determined.

Leaving, however, these two Latin terms as the lesser offenders in one respect, though often the more serious in another, I revert to the use of "common," the *fons et origo* of my discontent. By a number of eminent writers it is used of the following British vertebrates:—

Mammals.	Birds.	Reptiles and Amphibians.	Fishes.
†Mole.	Wren.	Lizard.	*Sole.
Shrew.	Bunting.	*Snake (*i.e.*, Ringed Snake).	*Skate.
†Fox.	†Cuckoo.	†Viper.	
†Badger.	†Swift.	Frog.	
†Weasel.	*Buzzard.	Toad,	
*Seal.	Heron.	Newt.	
Rorqual.	†Sandgrouse.		
*Dolphin.	Sheldrake.		
Mouse.	Snipe.		
†Dormouse.	Sandpiper.		
*Hare.	Redshank.		
	*Gull.		
	Skua.		
	Tern.		

* Inaccurate. † Superfluous.

Where not absolutely inaccurate, the use of "common" is in many cases so clearly superfluous that its mere suppression with no substitute would answer the purpose. By superfluous, I mean that, as in the case of several of the fishes previously indicated as specifically termed "*vulgaris*," no other animal of the name occurs within the British region. Five of the mammals, with the sandgrouse among birds and the viper among reptiles, come under this head. In the case of the cuckoo and swift, the others of the same name are such rare stragglers that it is hardly worth distinguishing our familiar forms as "common." Only a little more than thirty occurrences (in two cases "several ') of the alpine swift and three of the needle-tailed species are admitted in the last edition of Harting's "Handbook" (1901), while of the three rare cuckoos that have visited us the same reliable authority gives twelve records of one, three of another, and one only of the third. Surely, then, to write of the common cuckoo or the common swift is a waste of six letters.

The objections, apart from this one of specific isolation, to the use of "common" are two. The word, taken in its everyday significance, makes no allowance for gradual approach to extermination. This is perhaps the more serious blemish of the two. Thus, it is ridiculous to write to-day of the buzzard (*Buteo vulgaris*) as common anywhere in these islands. The zeal of keepers and the greed of pothunters have conspired to reduce the remnant of this handsome bird to almost that irreducible minimum that immediately precedes virtual extinction. Though the hare cannot be admitted to the same category, yet without doubt the operation of the Ground Game Act has in many districts at any rate all but eliminated it from the fauna. But the hare comes under the second objection by reason of its absence from the northernmost portions of Scotland and Ireland, where it is replaced by the blue form. It is, therefore, inaccurate to retain a specific designation, applicable to the whole kingdom, which ignores the predominance—if not, indeed, exclusive occurrence—of a vicarious form over considerable tracts.

This second objection applies in the case of the so-called Common Seal, Dolphin, Gull, Snake, Sole, and Skate. Correct as it may be to regard these several forms as the prevalent species in some parts of the territories or seas, or at certain seasons of the year, strong exception must be taken to such arbitrary distinction as of general application in point of both place and season. As regards, for instance, the Common Seal (*Phoca vitulina*), apart from the increasing rarity and secretiveness of our British seals, this species is by no means so common in the Scilly Islands and on the Cornish coast generally as the Grey Seal (*Halichærus grypus*). This is pointed out by Mr. Millais in the opening volume of his splendid work on our mammals, and incidentally he gives much other information on the distribution of our various seals. Nor is the Common Gull (*Larus canus*) by any means so familiar at most of our seaside resorts, at any rate in summer, as either the Kittiwake (*Rissa tridactyla*) or Herring Gull (*Larus argentatus*), to the latter of which the term "common" might be applied with far less ground of complaint. The objection to applying the term "common" to the ringed snake is its danger rather than any error of fact, though the greater abundance of the viper (*Pelias*) over most of the island renders the use of the word in respect of the ringed snake (*Tropidonotus*) inaccurate as well as tending to inspire misplaced confidence in the more plentiful venomous serpent. With regard to the sole, something has already been said, and the Common Skate (*Raia batis*) is certainly less common on some parts of the coast than the Thornback (*R. clavata*) and elsewhere than the Homelyn (*R. maculata*).

It would be easy to extend the application of these objections, but sufficient has perhaps been said in support of a plea for revision of a term unsatisfactory on more grounds than one. Not all the objections which have been raised against any and every proposal for renaming animals, in view of priority or otherwise, can be regarded as having the same force as that which contends that the criticised term is absolutely inaccurate.

Electrical Teaching Model.

A NEW piece of apparatus has just been brought out by the West London Scientific Apparatus Co. for demonstrating and explaining in a simple way the various actions in the electric circuit. It consists of a series of glass tubes, through which coloured water is driven by a small centrifugal pump. By this means, current strength, electromotive force, internal and external resistance, and fall in potential down a conductor, may be clearly illustrated.

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British Association Meeting, 1905.

PREPARATIONS are progressing for the meeting which is to be held in South Africa commencing on August 15.

A Central Executive Committee has been constituted at Cape Town, with Sir David Gill as Chairman and Dr. Gilchrist as Secretary; while local Committees have been formed at Johannesburg and other important centres.

Sir David Gill, Mr. Theodore Reunert, and others have taken a prominent part in the initial work. The South African Association for the Advancement of Science are cordially co-operating in the local organisation, and will join with the British Association in attending the meeting.

The aim of the Council has been to secure the attendance of a representative body of British men of science, including specialists in various lines of investigation; and that, along with the generous support of the people and authorities in South Africa, should go far to ensure the success of the meeting and to stimulate local scientific interest and research.

The Central Executive Committee in Cape Town have invited as guests 150 members, who will comprise members of the Council, past and present general officers and sectional presidents, the present sectional officers, and a certain proportion of the leading members of each section. To this list has yet to be added, on the nomination of the Organising Committee, the names of representative foreign and Colonial men of science, the total number of the official party being restricted to 200, including the local officials. It is hoped, however, that many other members of the Association will also attend the meeting.

Professor G. H. Darwin, F.R.S., is the President-elect; and among the Vice-Presidents-elect are the following: The Right Hon. Lord Milner, the Hon. Sir Walter Hely-Hutchinson, Sir Henry McCallum, the Hon. Sir Arthur Lawley, Sir H. J. Goold-Adams, Sir David Gill, and Sir Charles Metcalfe.

The Presidents-elect of the various sections are as follows:—

A. Mathematical and Physical Science—Professor A. R. Forsyth, M.A., Sc.D., F.R.S.

B. Chemistry—G. T. Beilby.

C. Geology—Professor H. A. Miers, M.A., D.Sc., F.R.S.

D. Zoology—G. A. Boulenger, F.R.S.

E. Geography—Admiral Sir W. J. L. Wharton, K.C.B., F.R.S.

F. Economic Science and Statistics—Rev. W. Cunningham, D.D., D.Sc.

G. Engineering—Colonel Sir Colin Scott-Moncrieff, G.C.S.I., K.C.M.G., R.E.

H. Anthropology—A. C. Haddon, M.A., Sc.D., F.R.S.

I. Physiology—Colonel D. Bruce, M.B., F.R.S.

K. Botany—Harold Wager, F.R.S.

L. Educational Science—Sir Richard C. Jebb, Litt.D., M.P.

The Vice-Presidents, Recorders, and Secretaries of the 11 sections have also now been appointed.

In view of the numerous towns to be visited by the Association, and in which lectures or addresses will be given, the number of lecturers appointed is much larger than usual. The list of these, as at present arranged, is as follows:—

Cape Town—Professor Poulton, on Burchell's work in South Africa; and Mr. C. V. Boys, on a subject in Physics.

Maritzburg—Professor Arnold, on Compounds of Steel.

Johannesburg—Professor Ayrton, on Distribution of Power; Professor Porter, on Mining; and Mr. G. W. Lamplugh, on the Geology of the Victoria Falls.

Pretoria (or possibly Bulawayo)—Mr. Shipley, on a subject in Zoology.

Bloemfontein—Mr. Hinks, on a subject in Astronomy.

Kimberley—Sir William Crookes, on Diamonds.

As the wish has been conveyed to the Council from South Africa that a few competent investigators should be selected to deliver addresses dealing with local problems of which they possess special knowledge, a geologist, a bacteriologist, and an archæologist have been invited to undertake this work, involving in two cases special missions in advance of the main party. Whilst Colonel Bruce, F.R.S., will deal with some bacteriological questions of practical importance to South Africa, Mr. G. W. Lamplugh (by the courtesy of the Board of Education) will be enabled to investigate certain features in the geology of the Victoria Falls, particularly as regards the origin and structure of the cañon; and Mr. D. R. MacIver, who is at present exploring in Nubia, will proceed in March to Rhodesia in order to examine and report on the ancient ruins at Zimbabwe and also Inyanga.

Most of the officials and other members of the Association will leave Southampton on July 29 by the Union-Castle mail steamer *Saxon*, and arrive at Cape Town on August 15, the opening day of the meeting; but a considerable number will start from Southampton on the previous Saturday, either by the ordinary mail-boat or by the intermediate steamer sailing on that date.

The sectional meetings will be held at Cape Town (three days) and Johannesburg (three days). Between the inaugural meeting at the former and the concluding meeting at the latter town opportunities will be offered to members to visit the Natal battlefields and other places of interest. Subsequently a party will be made up to proceed to the Victoria Falls, Zambesi; and, should a sufficient number of members register their names, a special steamer will be chartered for the voyage home, *via* Beira, by the East Coast route, as an alternative to the return through Cape Town by the West Coast route. Thus all the Colonies and Rhodesia will be visited by the Association. The tour will last 70 days *via* Cape Town, or a week longer *via* Beira (all sea), leaving Southampton on July 29, and returning thither on October 7 or October 14.

A New View of the Stars.

By T. E. HEATH.

THE usual Star Maps represent the heavens, as we see them, in perspective. The nearer stars therefore are drawn of larger and the more distant ones as of smaller magnitudes than they would be shown if it were customary to make plans and elevations of the Universe upon which everything was true to scale. We are thus confirmed in the tendency, to which we are naturally prone, to regard ourselves, our Earth, and our Sun as the most important objects in space.

Astronomers who now know, more or less correctly, the parallaxes of a considerable number of stars, being accustomed to think of stellar distances in seconds of arc, are not thus misled, but to the general reader these angular measurements do not convey much idea of distance. We are told that one second of arc (1″·00) is the angle subtended by a halfpenny, which is one inch in diameter, at a distance of 3·26 miles; that the parallax of the nearest star is only 0·75″, and that stars which have only a parallax of 0·01″ can just be measured. Astronomers tell us these things, but we cannot easily think in these terms.

We, in this country, are accustomed to think of small spaces in inches and long distances in miles. Now it fortunately happens that, if we represent the distance which light travels over in one year by one mile, the Sun upon the same scale will be represented by a dot (.) only $\frac{1}{107}$ of an inch in diameter, the earth by a microscopic point placed at a distance of exactly *one inch* and Neptune, at the furthest known boundary of the Solar System, will be only one pace (of 30 inches) from the Sun. If we draw a map upon this scale, the nearest known star would be $4\frac{1}{3}$ miles from the Sun, and we can put down all the stars of which the parallaxes are known upon our Map and form a clear mental picture therefrom.

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We will then place the Sun at Greenwich Observatory. We shall need a table 5 feet in diameter to represent the whole of the solar system upon. We will divide space up into concentric spheres, the Sun being at their common centres. These space spheres will on our map be represented by circles. The first circle we will draw with a radius of 5 miles, to represent a space sphere of 5 light-years radius; but we shall, besides the Sun, have here only one star to locate. This will be α Centauri, and we must place it 4·34 miles from the Observatory—it will come near Bromley.

We will now draw another circle at 15 miles radius. We have 9 times the area of the first circle, but we must recollect it represents a sphere of space, and is therefore 27 times the volume of the space sphere of 5 light-years radius.

We shall here be able to map, including the first sphere, from the stars whose parallaxes are known, in the Northern Hemisphere 14 stars, 1 central star (the Sun), and 6 stars in the South. But the Southern Hemisphere is, so far, less completely surveyed than the Northern, so that we may expect to add, say, 6 stars to the South, making a total of 27 stars.

We have, therefore, a probable average of 1 star for

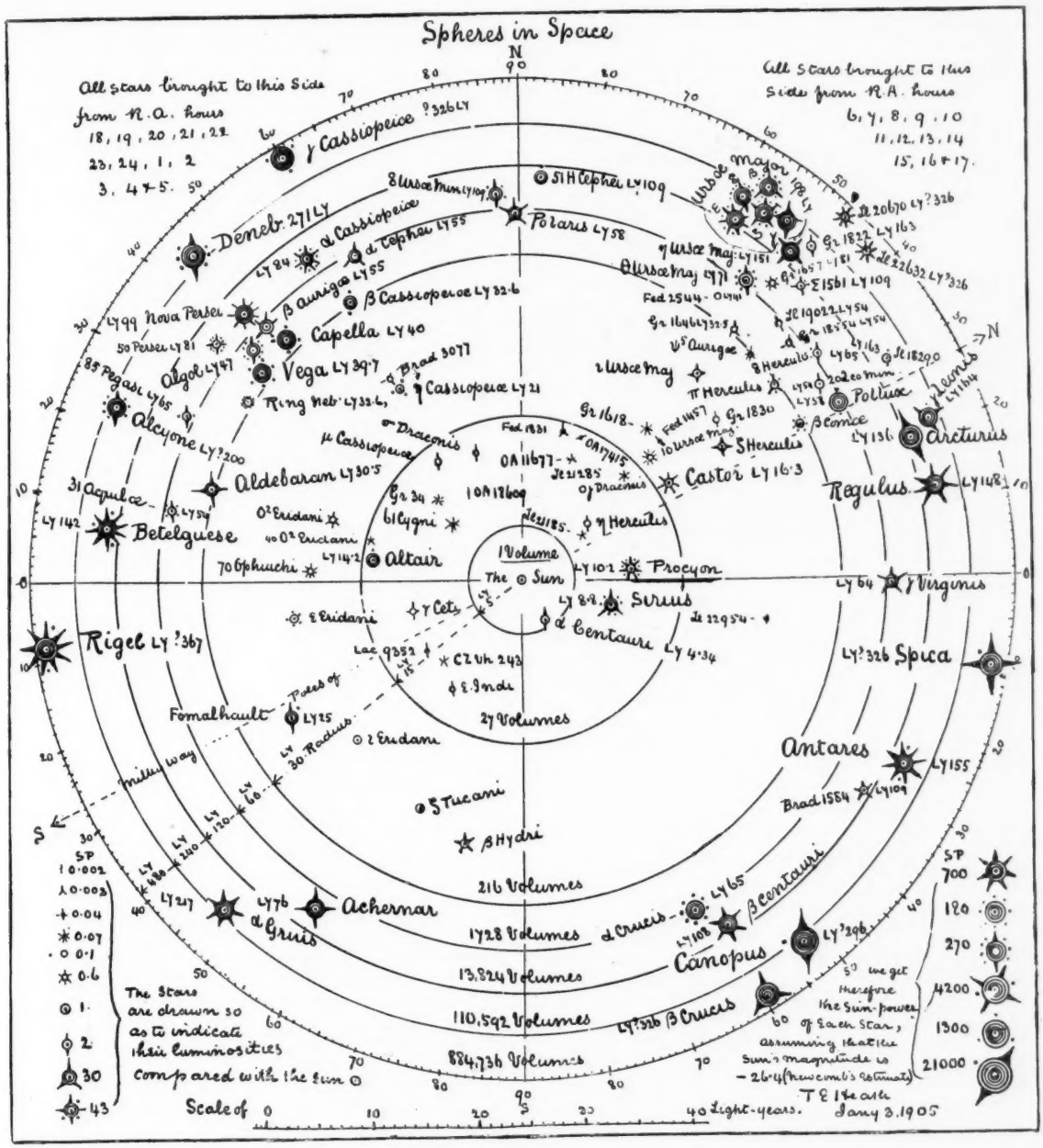


Fig. 1.

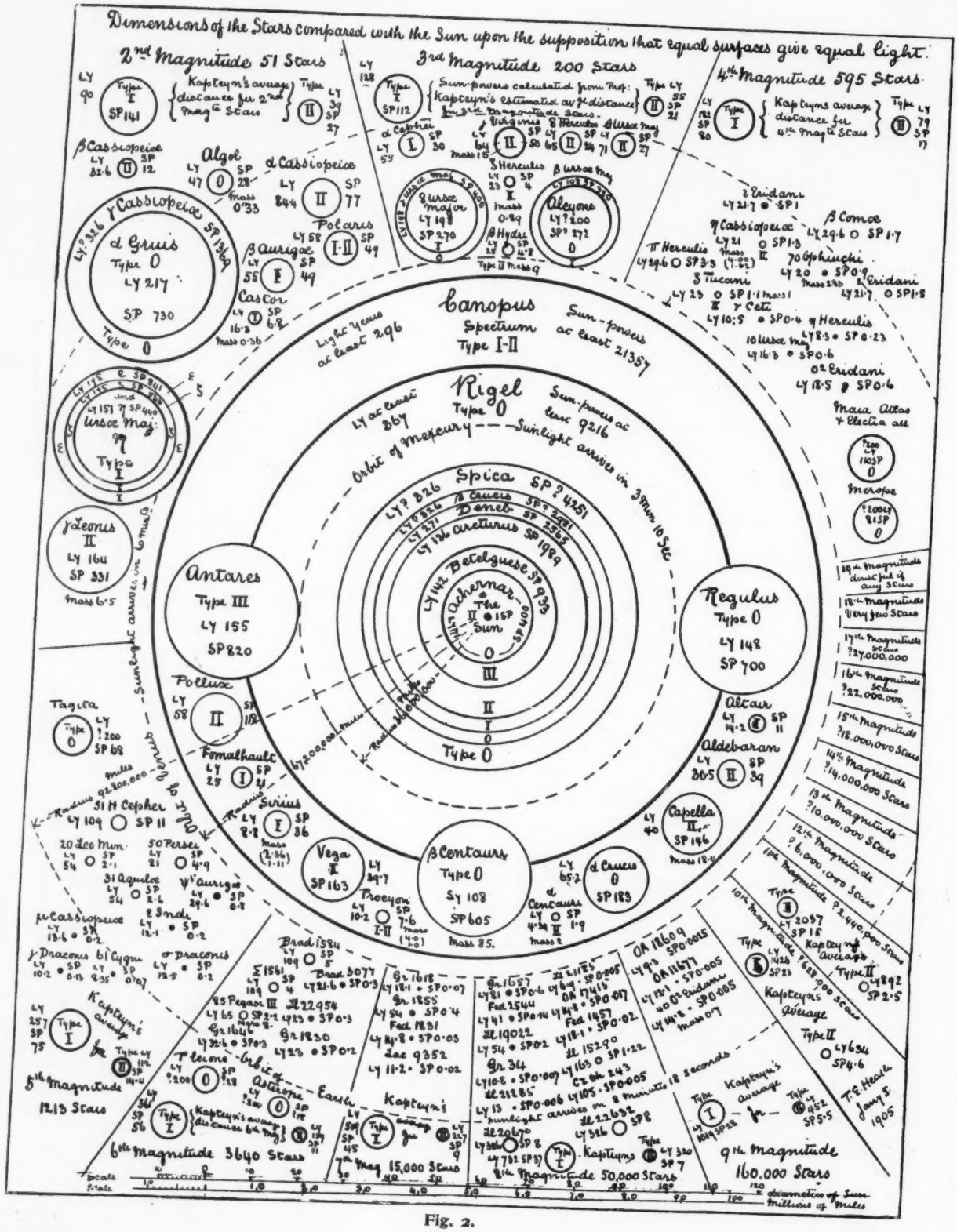

Dimensions of the Stars compared with the Sun upon the supposition that equal surfaces give equal light.
2nd Magnitude 51 Stars
3rd Magnitude 200 Stars
4th Magnitude 595 Stars
Kapteyn's average distances for 2nd mag.a Stars
Sun-powers calculated from Rap: Kapteyn's estimated av.e distances for 3rd magnitude Stars.
Kapteyns average distance for 4th mag.a Stars
Canopus
Spectrum Type I-II
Light years at least 296
Sun-power at least 21357
Rigel
Type 0
LY at least 367
Sun-power at least 9216
Orbit of Mercury
Sunlight arrives in 3 Hun 10 Sec
Spica
Arcturus
Betelgeuse
Achernar
The Sun
Antares
Type III
LY 155
SP 820
Regulus
Type 0
LY 148
SP 700
Pollux
Fomalhault
Sirius
Altair
Aldebaran
Capella
Vega
Procyon
β Centauri
Type 0
LY 108
SP 605
Mass 85.
α Centauri
Tagica
31 H Cephei
20 Leo Min
50 Persei
31 Aquilæ
ψ1 Aurigæ
μ Cassiopeiæ
ξ Ursæ
γ Draconis
b1 Cygni
σ Draconis
85 Pegasi III
Groombridge 1830
Groombridge 1618
Groombridge 1855
Groombridge 1830
Kapteyn's average for 5th Magnitude 1213 Stars
Kapteyn's average for 6th Magnitude 3640 Stars
Kapteyn's average for 7th Mag 15,000 Stars
Kapteyn's average for 8th Magnitude 50,000 Stars
Kapteyn's average for 9th Magnitude 160,000 Stars
Orbit of Asterope
Earth
Scale of Diameters
Scale of Distances
Millions of miles
Diameter of Sun
Mizar
Alcyone
Algol
Polaris
Cas Cor
Merope
Maia Atlas
Electra
Taygeta
Kapteyn's average for 10th Magnitude 2,440,000 Stars
Kapteyn's average for 11th Magnitude 6,000,000 Stars
Kapteyn's average for 12th Magnitude 10,000,000 Stars
Kapteyn's average for 13th Magnitude 14,000,000 Stars
Kapteyn's average for 14th Magnitude 22,000,000 Stars
Kapteyn's average for 15th Magnitude 38,000,000 Stars
Kapteyn's average for 16th Magnitude 27,000,000 Stars
Kapteyn's average for 17th Magnitude Very few Stars
Kapteyn's average for 18th Magnitude Scarcely any Stars
Kapteyn's average for 19th Magnitude Scarcely any Stars
T Coronæ Borealis
June 5 1905

Fig. 2.

each space sphere of 5 light-years radius; or, in other words, the stars are probably at an average distance of 5·13 light-years apart. The survey of star distances beyond this radius is, at present, so imperfect that we can draw no conclusions therefrom as to the stellar density in space.

Professor Newcomb, however, says in his book on "The Stars" that as far as the stars which have any considerable proper motion go, they are pretty equally scattered over the sky. These are the stars which are presumably the nearest to us; in fact, no measurements we are likely to make will go beyond them, so that I will assume as far as we have measurements the stars are at intervals of 5·13 light years apart.

We will double the radius for each succeeding sphere, and, still measuring from Greenwich, we should enclose within the boundary of each space the total number of stars marked A; but, so far, I can only find parallaxes for those marked B.

Miles Radius.	A	B	Northern.	Southern.
30	216 stars	40 stars	= 28	+ 12
60	1,728 ,,	56 ,,	= 44	+ 12
120	13,824 ,,	70 ,,	= 53	+ 17
240	110,592 ,,	85 ,,	= 66	+ 19
480	884,736 ,,	93 ,,	= 70	+ 23

We have now got as far as parallaxes will take us, rather further indeed, for we can hardly place at their true distances those stars added by the last sweep. Sir David Gill, for example, says Canopus gives a parallax of 0·00″, but this only means he is sure it does not exceed 0·011″ (at least 296 light-years).

It will be instructive, however, if we continue making circles, and assume the stars still average 5·13 light-years apart.

At	960 light-years radius we enclose	7,007,888	stars.
	1,920 ,, ,, ,,	56,623,104	,,
	3,840 ,, ,, ,,	452,984,823	,,

But this is probably four times as many as the total number of stars which could be photographed by prolonged exposure in the largest telescopes, and Dr. Isaac Roberts has proved we thus reached the boundary of our stellar universe, because all stars shown by exposures of 7 or 12 hours are also shown, down to the smallest magnitudes, by only 90 minutes' exposure. The best estimate I could find of the total number of stars of each magnitude is by Mr. Gore ("KNOWLEDGE," 1901, p. 178). He makes the total about 100,000,000 (probably about 70 per cent. are in the Milky Way).

This map I have described, on which light travels one mile in one year, will cover England and stretch beyond. It is too big to use. I have, therefore, constructed one upon a much smaller scale, fig. 1; but to realise what it means the large map should always be kept in mind. Even so, I have only been able to set down the stars to scale as far as the 30 light-years radius; beyond that each circle on my map is supposed to be twice the radius of the preceding one. It will be borne in mind that, as spheres of space are represented by circles on a plane surface, two stars which appear near together on the map may be really far apart. The distances from the Sun, however, and from the Equator are approximately correct.

We are accustomed to think of gas and electric lights as being of so many candle-power each. I have therefore drawn the stars of different shapes, which distinguish how many Sun-powers each star is. Within the 15 light-years circle, for example, it will be found there are several stars which give less light than the Sun, and some which give more. It would take 200 stars as bright as o A 11677 to equal the Sun, but it would take 36 Suns to give as much light as Sirius, which is 8·8 light-years away.

In the map the Sun, or a star of one Sun-power, is drawn thus ⊙, and three rays are added for a star of three Sun-powers; circles are added for tens, hundreds, &c. I have however, in fig. 2, drawn the dimensions of the stars compared with the Sun on the supposition that equal surfaces give equal light. Probably this is true only of stars of the solar type.

Though small stars are no doubt equally abundant at all distances they are not equally noticeable. On our map, therefore, we shall find the Sun-power recorded increases with the average distance. For example, at 39 light-years, we get Vega 163 Sun-powers; at 40 light-years, Capella 146 Sun-powers; at 76 light years, Achernar 400 Sun-powers; at 136 light years, Arcturus 1989 Sun-powers; and at from 270 to 480 light years, Rigel, Spica, and Deneb, from 2500 to 9200 Sun-powers, and Canopus at least 21,000 Sun-powers. To make my new view of the stars I searched all recent astronomical works I could find for the best estimates of parallax. I gave the preference to those made by Gill, Elkin, and at Yale. The Sun-powers I worked out upon Professor Newcomb's estimate that the Sun's magnitude is 26·4 (Gore says 26·5), and, as far as I could, I used the Harvard estimates of stellar magnitudes.

No doubt many of the data are uncertain, but the best estimate obtainable is worth recording, though, if very doubtful, I marked it (?). It is to be hoped we shall soon have heliometer parallaxes for all the second magnitude stars equal to those for the first, and that by photography measurements will be reached for many small stars.

A model would be more instructive than a map. What could be a fitter place than the dome of St. Paul's Cathedral? The Sun in the centre and all the Stars hung round it, as their distances become known. They would be incandescent globes, and the candle power of each should be proportionate to the Sun-power of the star.

For a model, however, or for a small map, such as I have drawn, to convey any real idea of the dimensions of our stellar universe, the great world-spreading map I have described should be mentally referred to; for in that the Earth is actually one whole inch from the Sun and the solar system no less than five feet in diameter.

I do not mean that we should think of space coming to an end at a distance of 3800 light-years; indeed, we cannot think of it coming to an end at any distance. It may well be that in the infinite ocean of space there are many islands of light, of which our own stellar universe is one; we cannot tell, for we are far out of sight of any other land.

That our own stellar universe is limited is nearly certain; for otherwise, if light-giving stars be scattered throughout the whole of infinite space (unless perchance they be eclipsed by the dead, dark orbs which also wander there), the night would be as bright as the day, and day and night the whole heavens around us would blaze with an intolerable glory.

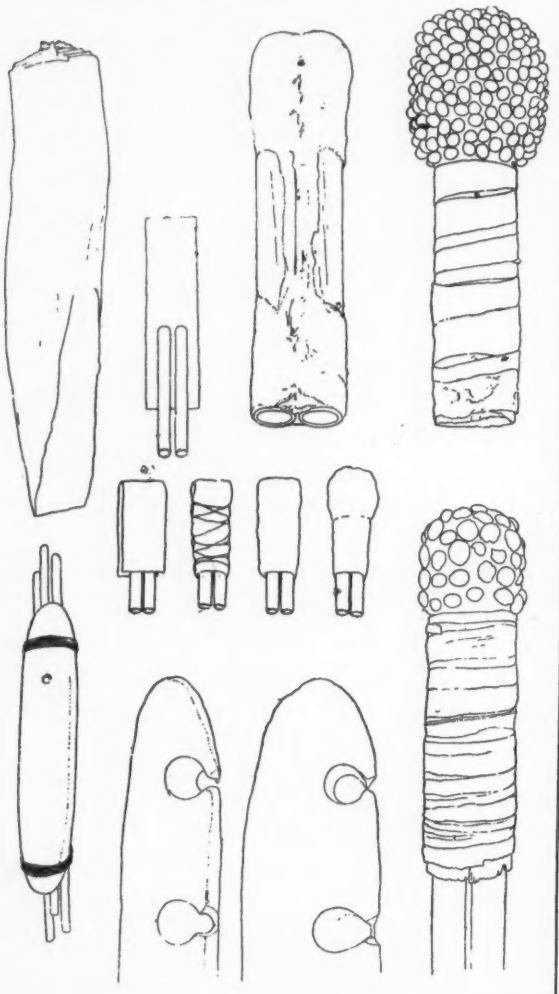
Lantern Slides.

WE have received a supplementary list from Messrs. Newton and Co. of their new lantern slides for lecture and other purposes. These include series on Radium, Sand Figures, Rock formation, Starry Heavens, Trees and Plants, and others of a scientific nature.

XUM

Queensland Fire Sticks.

SOME extremely valuable information on the Domestic Implements, Arts, and Manufactures of the Queensland natives is comprised in the Bulletin of North Queensland Ethnography, which is presented to the Queensland Government by Mr. Walter E. Roth, whose official title is the appropriate one of "Chief Protector of the Aboriginals."



Among other things described by Mr. Roth is the process of making "fire-sticks," and of using them to procure fire.

The fire-sticks are thin wands from two to four feet in length, and are often capped with a knob of beeswax and leaf or of shells. The grass tree is the one from which the fire-sticks are most often cut; and the process of firing-up has not changed from the days in which Captain Cook described it. "They take," said Captain Cook, "two pieces of dry soft wood—one is a stick, the other piece is flat; the stick they shape into an obtuse point at one end, and pressing it on the other turn it nimbly by holding it between both their hands as we do a chocolate-mill, shifting their hands up, and then moving them down on it, to increase the pressure as much as possible. By this method they get fire in less than two minutes, and from the smallest spark they increase it with great speed and dexterity." To make a beginning the horizontal stick may have a small excavation punched into it with a sharp stone, &c., so as to give the extremity of the vertical one a firmer basis of support, it being very liable otherwise to slip off the rounded edge. What with the firm downward pressure and simultaneous twirling with the flats of the hands a circular concavity very quickly results: if a fresh one, some charcoal dust may be placed in it. As the concavity is being formed the finely-triturated particles removed from it collect like a miniature dust-heap around its mouth. Piled up on the underlying leaf or ground and covering over that portion of the edge of the horizontal piece contiguous with the excavation is a small pinch of fine dried-grass particles, pith-dust, bits of the prickly tops from the grass-tree, &c., arranged in such manner as actually to touch the edge of the excavation, on a windy day especially, and commonly to save labour, the pile of dried grass, &c.—the "tinder"—may be led up along an artificial nick extending from the excavation to the edge. As the finely triturated dust-particles from the horizontal piece become heated, blackened, smoked, burnt, and removed by the simultaneous twirling and friction a spark forms and comes into contact with the tinder; directly this takes place the latter is quickly whipped up, usually with a bunch of dried grass swung round and round in the air, perhaps blown on, and so made to burst into flame.

Hardly less interesting are Mr. Roth's observations on the "uses of the colours" among the aboriginals. White is essentially the colour of mourning, sorrow, and tribulation, and is met with during the ceremonies connected with burial. But in some areas of the colony and among some tribes it is a "fighting" colour, thus reversing in another sense the practice of European nations, where the "white flag" or the "white feather" have the precisely opposite significance. The usual oriflamme of war, however, among the natives is red. Red adorns warriors on their fighting expeditions, and paints their weapons; it is also found on their fire-sticks, and is even associated with magic. The Bloomfield natives by holding out the red flag can ward off impending danger from friendly spirits. On three rivers and their hinterland, however, red is associated with death, and the natives there signify mourning by a red flower or feather fixed to the forelock. Old men and women among the Brisbane blacks wear red as mourning for their children. Of less esoteric origin is the use of yellow. Yellow is the colour for withstanding heat, and in the heat of summer the natives cover themselves from head to foot with yellow pigment. It is, as a decoration, a woman's rather than a man's colour. Black is only used sparingly; and on the only occasion when Mr. Roth saw natives entirely covered with it they were representing "crows" at some very high initiation ceremonies. Mr. Roth does not agree with those who say that the natives possess undeveloped colour-sense or colour-vision. He has found words which indicate accurate subdivision of the principal colours. White, in the sense of colour, is bilbin, dingga; in the sense of light, clear, &c., especially in the case of water, kandal; as a particular pigment, garmai. Red, in the sense of a colour, is dini, and is also expressed as woba-dir, *lit.* with the "woba" (a red pigment); in the latter case, the colour is still associated with the pigment, much in the same way as we speak of the terms "raddle" and "raddled." Yellow is barga, the name of the particular pigment. Blue is dalon; the natives speak of purai-dalon, "water-blue," to distinguish deep from shallow water. There is no name for green, the existence of which colour is certainly recognised, but has not been dissociated from the objects, grass, leaves, with which it is ordinarily connected. Grey, although recognised, is appreciated only in the term for grey hair (pinga) as distinguished from the normal black hair (moari). Chestnut is yetchel, but applied to animals only. Auburn hair is called "moari-ngalan" or sun-hair, which is not unlike our expression of "sunny ringlets."

The Ears of Fishes.

By WILFRED MARK WEBB, F.L.S., Honorary Secretary of the Selborne Society.

With Illustrations from Photographs by the Writer.

THOSE who look only at the outside of a fish's head may, perhaps, be pardoned for jumping to the conclusion that it has no ears because there are no external evidences of their presence. At the same time we have only to recall the accounts which exist of carp regularly coming to be fed at the sound of a bell to appreciate that fishes hear, and, therefore, must have auditory organs of some kind. Dr. Zenneck, of Strassburg, has also shown by special experiments that fishes are sensitive to sound vibrations and are frightened when an electric bell is rung under water. Care was taken by first placing the bell in a pail to prevent any disturbance of the water which might alarm the fish. As a matter of fact, the ears of these animals are well developed, and differ only in matters of detail from our own; though in these very points of difference much of their interest lies. If we look at the first illustration, which is the photograph of the internal ear of the cod-fish (Fig. 1), we shall see that the three semi-circular canals are present which we find in the higher vertebrates, and which it is generally supposed enable us to judge of the position of our heads with regard to our bodies and to the earth's surface.

Fig. 1.—The Right Internal Ear *(auditory capsule)* **of a Cod, showing the semi-circular canals and the large otolith or sagitta in position. Seen from the outer side and slightly enlarged.**

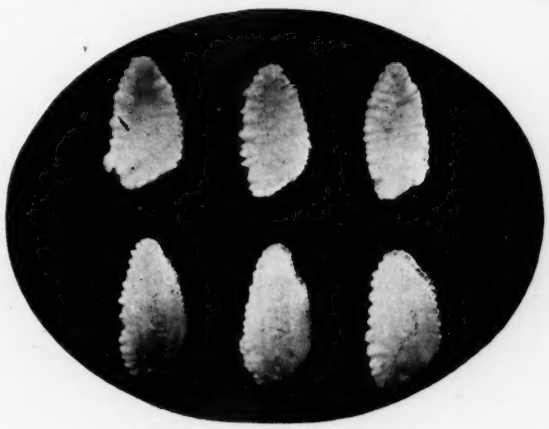


Fig. 2.—The Large Otoliths of the Cod.

We notice, however, that the spiral prolongation of the sacculus, which we know as the cochlea, is absent from the fish, and we do not see the three small bones which play an important part in connection with vibration in the mammalia. There is a very good reason for this, for in fishes these bones are still put to their original use and form part of the ordinary skull. In bony fish, however, we find otoliths, or stony structures (Fig. 2), which may be of a large size and situated in special parts of the internal ear. Many of these ear stones are of peculiar shapes, and though the majority are white in colour, they are usually finely sculptured in a characteristic manner. There is no doubt that they make an attractive collection, and are surrounded with a good deal of interest, as we shall see.

We may first of all point out that there are typically three otoliths, and their positions are shown on the accompanying diagram (Fig. 3) taken from a drawing made by Mr. E. T. Newton, of Jermyn Street Museum,

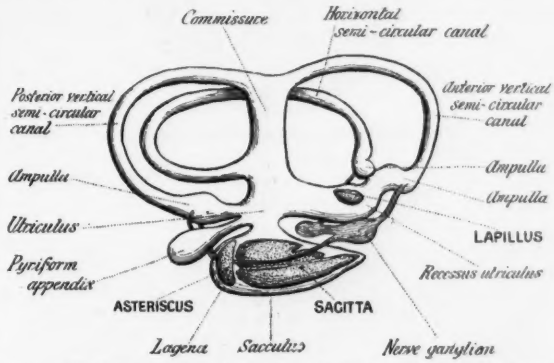


Fig. 3.—The Left Auditory Capsule of the Pike, seen from the inner side, showing the positions of the various otoliths.
(Modified from a drawing by E. T. Newton, F.R.S.)

which he has been so kind as to put into my hands. The largest otolith is the "sagitta," which lies in the sacculus and is seen also in the first illustration. The second is situated not far from the first in that part of the ear which corresponds to the cochlea. The third is in one part of the utriculus, and is called the lapillus. The sagitta is usually the largest, and, therefore, is the easiest to find, especially in fish that have been cooked and brought to the table; for it is possible to pursue the study of otoliths, on occasion, at meal times. Some amusement can be had by those familiar with these objects at restaurants should small haddocks be served up under the name of whiting. The flavour may lead the diner to doubt the claims of the fish to its title, but few external characters, if any, remain which would prove it to be an impostor. Whitings and pseudo-whitings perforce are cooked with the head in place, and very little trouble will serve to make matters quite clear. The large otoliths can easily be removed with one's knife and fork from the back of the skull and the species of fish determined without a doubt. The sagitta in the haddock (Fig. 4) resembles that of the cod (Fig. 2), though it is longer and somewhat narrower in proportion, while that of the whiting (Fig. 5) is produced into a long point and is larger compared with the size of its owner. With this evidence up one's sleeve, should one be acquainted with the

manager of the restaurant, it is possible to approach him and playfully accuse him of fraud. He will, of course, stoutly maintain that the description on the menu is correct. He will nevertheless probably state his intention of consulting the contractor who supplies him with fish, and on your next visit will inform you that the fishmonger has owned that you were quite right, though only one person in a thousand, if that, is

Fig. 4.—The Large Otoliths of the Haddock.

aware of the difference between the two fish upon which you have based your contention.

As we have said before, otoliths have those characters which the collector of natural history objects is accustomed to look for, and though brittle, they are not perishable. They are not unwieldy; within limits they present great variety of shape and size, if not of colouring, and they form very pretty collections that

Fig. 5.—The Large Otoliths of the Whiting.

cannot be brought together without just sufficient trouble to keep them from becoming too common. There is fortunately another aspect from which such a collection may be looked upon. Very little is known about otoliths, and it is possible to form a very fair idea of the structures and affinities of the fish whose otoliths are found fossil by comparing them with examples from modern forms. As a matter of fact some of our modern fishes have been proved to have existed at the time that the red crag, familiar to visitors on the East Coast, was laid down. Very few collections of any size exist, and as one is necessary to the geologist who wishes to study fossil otoliths, Mr. E. T. Newton has formed an extensive one for his own use. It is surprising how much trouble may be taken and even danger experienced in obtaining

Fig. 6.—The Large Otoliths or Ear Stones of the Hake (somewhat enlarged).

a new fish of which the tiny otolith only remains to remind the enthusiastic collector. We give photographs of one or two other ear stones which are easily obtained. Those of the cod are a fair size, while those of the hake (Fig. 6) are much larger, comparatively. Those of flat fish (Figs. 7 and 8) are fairly characteristic. Turning to one or two others we may point out that the ear stones of the salmon are not particularly large, though in certain freshwater fish, such as the bream, the three stones are well developed and are more of a size than in many marine fish. The sagitta of the pike has several very elegant points. That of the gurnard has a slit at one end, while that of the wrass is practically Y-shaped. The sagitta has as

Fig. 7.—The Large Otoliths of the Plaice.

a rule a peculiar groove on one side which, as Mr. Newton has found, presents features that are characteristic of the different families of bony fishes.

Occasionally, large otoliths, like those of the cod, have been used as embroidery, while those of some Mediterranean species have been mounted to form jewellery. Probably the taste which has arisen for ornaments made from irregular pearly masses known

as "baroque" has led to this, but it must be remembered that otoliths have the porcellanous texture of the interior of the common oyster-shell and lack the sheen and play of colours characteristic of mother-o'-pearl.

Fig. 8.—The Large Ear Stones of some other Flat Fish.

Turning now to other orders of fishes we find that while ganoids such as the sturgeon have more or less well developed ear stones, the cartilaginous fishes, such as sharks and skates, have in the sacculus a number of separated grains instead of a solid mass.

Radium—the Cause of the Earth's Heat.

PROFESSOR E. RUTHERFORD, F.R.S., has written an interesting and most noteworthy article in the February number of *Harper's Magazine* under the above title. After referring to the controversy between Geologists and Physicists regarding the age of the earth, he discusses the cause of the heat in the earth and the sun, and points out that while the heat supplied by possible chemical combination is inadequate to account for this, the fact that radio-active bodies are able to emit a great amount of heat throws quite a new light on the question. "In the course of a year," says this great authority, "one pound of radium would emit as much heat as that obtained from the combustion of one hundred pounds of the best coal, but at the end of that time the radium would apparently be unchanged and would itself give out heat at the old rate." And it is probable, he adds, that it would continue to do so for about a thousand years.

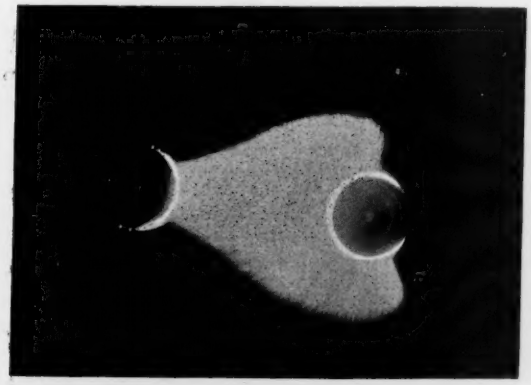
The author then describes how all radio-active bodies must emit heat, although in lesser comparative amounts; thus the heating effect of uranium is probably only about one millionth part of that shown by an equal weight of radium. Yet radio-active matter has been found to be distributed, in minute quantities, throughout the atmosphere and the crust of the earth. "These emanations are not produced in the air itself, but are exhaled from the earth's crust which is impregnated with radio-active matter." Professor Rutherford then comes to a remarkable conclusion. "Since the radio-active substances present on the earth are continuously expelling α particles, heat must be evolved in amount proportional to the quantity of active matter present and to the intensity of the radiations. The question then arises, is the amount of radio-active matter present in the earth sufficient to heat it to an appreciable extent? I think that even with our present knowledge this question must be answered in the affirmative." In support of this he continues, "Since one gramme of radium emits enough heat each hour to raise one hundred grammes of water through 1° C., a simple calculation shows that the present loss of heat from the earth is equivalent to that supplied by the presence of about 270 million tons of radium. This amount may seem very large compared with the small quantities of radium hitherto separated, but is small, for example, compared with the annual output of coal from the world. It can readily be deduced that this amount of radium, if distributed uniformly throughout the earth's crust, corresponds to only five parts in one hundred million million per unit mass. This is a very small quantity, and calculations based on the observations of Elster and Geitel show that the radio-activity observed in soils corresponds to the presence of about this proportion of radium."

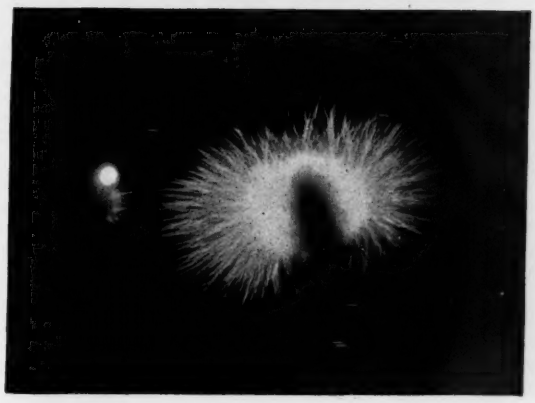
CORRESPONDENCE.

Spark Electrographs.

TO THE EDITORS OF "KNOWLEDGE."

SIRS,—*Re* spark electrograph shown in your last issue. During a series of investigations, made nearly two years ago,





of the phenomena preceding spark discharge, I had occasion to make many electrographs showing the field between the electrodes of the gap in the various stages of the strains breaking down the di-electric strength of the air. The enclosed are two of them. One shows the invisible brush which evolves just before the spark passes—the other is of the tentative feelers being emitted by the positive prior to the formation of the negative component.

As there is a considerable field open to experimenters in this direction you may care to publish these electrographs.

Yours faithfully,
ALFRED WILLIAMS.

Laboratory, Meadow House, Ealing, W.,
February 6, 1905.

Photography.

Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

Time Development.—This means the treatment of exposed plates to a prepared developer for a fixed time, which may have to be varied a little according to the temperature and will not be the same for different developers or plates of different makes, but which is not varied to suit the subject or the exposure. The plates are put into the developer for the specified time and then fixed and washed without inspection. The use of the Kodak developing machine renders the following of this method obligatory, for inspection during development is then impossible. There are modifications of time development that allow for variations of temperature and certain changes in the developer, but I refer now to the simple method just stated.

There has been considerable argument and some dogmatic expression of opinion as to whether time development is advantageous, whether, indeed, there is *any* advantage in any other method. The case in favour of it was very strongly set forth by Mr. R. Child Bayley, a week or two ago, in a lecture at the Society of Arts, and the Chairman, Mr. George Davison, emphatically supported the lecturer, showing prints from negatives of the same subject that had received exposures of 1, 2, 4, and 8 units of time, and had been developed together for the same time. The longer the exposure the denser the negative and the longer the exposure required for printing from it, but the prints from these negatives were all satisfactory and not very different from one another.

The advantages of such a mechanical method of development are obvious. There is no light fogging—for the plate may be kept absolutely in the dark; the fingers are not dabbling in the solution—for the plate is not removed from the dish until the time is up; all doubt as to when development is complete is removed—for any one can read a clock though few can tell by inspecting an unfixed plate whether the image is satisfactory; in the Kodak machine a whole roll of exposures is developed at once, so that much time is saved; and all risk of damage to the film is obviated because it is perfectly supported and not touched during development and fixing. The question is what do we give up for these very notable advantages? Some say, Nothing, and that what we imagine we lose is merely a matter of fancy or sentiment. With regard to the vast majority of those who develop photographs I believe this to be absolutely true, and that the net result of adopting such a method would be found to be a considerable gain in the quality of the resulting negatives. But I also doubt whether there are more than perhaps one in ten thousand of those who do a little drawing and painting whose drawings are worth as much as an ordinary photograph of the same subject, and the fact that few excel is no proof that none do or that it is impossible to excel. I am convinced that the same is true with regard to development, and that with knowledge and practice, constant practice, that is, not merely the developing of a batch or plates three or four times a year, results may be obtained that mechanical methods could not give. This leads to another question: Is it worth while even for this exceptionally able and practised worker to bestow so much trouble in personal and detailed attention when the timing method gives such an excellent yield of good results? I very much doubt whether it is unless he is engaged on exceptional work.

It will be understood that these remarks are intended to apply to ordinary photography as it is commonly understood. But I have no doubt that much scientific photography would yield a better average of results with less trouble if development were simply timed. For exactly repeating definite results, the timing method (using the same developer at the same temperature) is the only way to justify the anticipation of success.

Improvements in Colour-Photography.—Messrs. Sanger-Shepherd and Co., who have done so much to make photography in colours possible for any one who can photograph at all, are introducing some notable improvements in apparatus and methods. The repeating-back camera is still to be preferred for subjects that permit of consecutive exposures for the three negatives (the red, green, and blue records), but the advantages of a camera that gives the three negatives side by side on the same plate by one exposure are so obvious that they do not need pointing out. Such a camera they have just perfected. It has only one lens, so that the triple exposure needs no more manipulation on the part of the photographer than if he were using any ordinary camera. This means that there remain now no limitations in the character of the thing or scene photographed other than exist in ordinary non-colour photography, except that, other things being equal, the exposure for the colour photograph must be rather longer. But with the plates now in use the length of exposure is very moderate. I have seen a very good portrait of a dog which was taken in ten seconds. The camera is compact, being no larger than necessary to carry the plate in two directions, and the size in the other direction is no more than sufficient to carry the lens in the front and the plate at the back as in ordinary apparatus. A very convenient size takes the half of a half-plate, divided longitudinally, and a larger size the third of a 10 by 8 plate.

The same firm will shortly have on the market a bathed plate—that is, a plate sensitised for colour after it is made instead of being coated with an emulsion already sensitised. The great advantage of such plates has long been known, but I believe that they have not before been obtainable commercially. The advantage is that they are so much more sensitive to red and green that the exposures for these colours are not very different from that needed for the blue image. Such plates in the camera mentioned above will require an exposure of only one second instead of about fifteen for average subjects, an advantage that will at once be appreciated by all practical photographers. With such an exalted sensitiveness to red, the plate has to be developed in the dark, unless the photographer knows how, by keeping his dish covered, and so on, to avoid light fog. The plates give very clean and bright negatives.

NOTES.

ASTRONOMICAL.

The Recent Large Sun-Spot.

ON the 28th of January a dark streak appeared on the sun's eastern limb, which from its length, and the very extensive masses of bright faculæ surrounding it, gave promise of an unusually large disturbance. On Monday morning, the 30th of January, renewed observations showed that the spot was the largest of any seen during the present increase of activity, and in fact may have been equal to the great spot of February, 1894.

By means of suitable smoked or coloured glasses it was quite easy to see the dark area of the spot on the sun's surface with the naked eye. Observations with telescopic aid of varying powers showed the umbra or dark centre of the spot to be split up into several portions by intensely bright streaks or "bridges," and these were found to be constantly changing as the sun was seen day after day. Towards the latter part of its visibility numerous small umbræ were developed on the following side of the main spot, this being a very common feature of sun-spot evolution.

In accordance with the time of the sun's rotation, 25·38 days, the spot reached and passed round the sun's western limb on the 10th of February, its path across the disc having had about a mean southerly latitude of 16°. At its greatest development the diameter of penumbra was about 2′ of arc = about 53,000 miles The spectroscopic observations of the spot have been most interesting and instructive. As might have been anticipated from the rapid changes in the telescopic form of the spot, the spectrum lines were observed to be considerably distorted both to the red and violet sides, indicating strong vortical disturbances to be existent in the spot area. Frequently many of the special lines which are known to be distinctive of spot spectra were seen to be bright, or reversed, in comparison with the dark Fraunhofer lines. These special lines, dark or bright, were identical with those observed generally in spot spectra, and consisted chiefly of very faint lines of the rare elements vanadium, scandium, titanium, and some unknown element or elements.

Detailed accounts of magnetic measurements are not yet to hand, but it is announced that on Friday, February 3, the magnets at Greenwich Observatory were disturbed about 1.30 a.m., the effect showing throughout the day. Reaching a maximum value towards midnight, the oscillation died away on the morning of the 4th of February, about 8.0 a.m. It may be noted that the large spot was near the central meridian of the sun's visible hemisphere about the time of the magnetic disturbance.

* * *

Jupiter's Sixth Satellite.

Shortly after the telegram from Professor Perrine announcing his discovery of a sixth satellite, there came an interesting despatch from Professor Wolf, stating that one of the minor planets photographed by him was very near to Jupiter, and suggesting that this might be the suspected satellite observed by Perrine. The following data give the co-ordinates of this new asteroid, 1905 P.V.:—

R.A. = 1h. 31m. 59s.
Decl. = + 8° 36′ 13″ } Jan. 23d. 7h. 8·8m. Koenigstuhl mean time.

Daily motion in R.A. = + 23′; daily motion in Decl. = − 9′.

The day after, however, Professor Perrine sent a further telegram, giving a new position for the satellite, and definitely stating that the object discovered at the Lick Observatory is *not* identical with the minor planet 1905 P.V. photographed by Professor Wolf. This new position of the satellite was:—

R.A. = 1h. 21m. 8s.
Decl. = + 7° 27′ } January 17d. 8h. 44·3 (Lick mean time).

Obervations on the 17th of January gave the following co-ordinates of position of the satellite with respect to Jupiter:—

Distance (r) = 36′
Position angle (θ) = 266° } January 17·702d. (G.M.T.)

* * *

New Form of Hydrogen in Stellar Spectra.

Hydrogen is well known to be present in the spectra of most of the stars which have hitherto been spectroscopically examined, the spectrum usually shown being that consisting of a rhythmical series of lines whose wave lengths are connected by Balmer's law. In November, 1896, Professor Pickering announced that on the photographs of stellar spectra obtained with the Draper Memorial telescope there had been found a star which showed a new series of rhythmical lines in addition to the ordinary hydrogen series. Subsequent discussion of their wave lengths elicited the important fact that they were undoubtedly due also to hydrogen, but indicated conditions of temperature and pressure hitherto unknown. This star was ζ *Puppis*, which, having a southerly declination of 39° 43′, was unfortunately inaccessible to the astronomers of northern latitudes. Quite recently, however, Professor Pickering has been able to announce that by examination of later photographs of stellar spectra it has been discovered that the star λ *Cephei* has a spectrum identical with that of ζ *Puppis*, and as this star, of declination + 58° 56′, attains a considerable altitude in northern latitudes, the instruments of European observatories will be available for its examination. It is somewhat unfortunate that it is a much fainter star than ζ *Puppis*, its magnitude being about 5·6, but with the large prismatic cameras which are now installed at many observatories this will not prove a serious drawback to its being observed.

* * *

Ephemeris for Observations of Comet 1904 d.

(12·0 midnight, Berlin Mean Time.)

The following positions have been computed by Ebell at Kiel Centralstelle:—

1905.	R.A.	Declination.	Brightness.
March 1	21 4 9	+ 61° 28 7	0·62
2	9 26	61 42·4	
3	14 43	61 55·6	
4	20 0	62 8·2	
5	25 17	62 20·3	0·58
6	30 33	62 31·8	
7	35 49	62 42·8	
8	41 4	62 53·2	
9	46 17	63 3·1	0·54
10	51 29	63 12·5	
11	21 56 40	63 21·4	
12	22 1 50	63 29·9	
13	6 58	63 37·9	0·50
14	12 4	63 45·5	
15	17 8	63 52 6	
16	22 10	63 59·3	
17	22 27 10	+ 64 5·6	0·47

Brightness in terms of that on 1904, Dec. 17 = 1.

BOTANICAL.

By S. A. SKAN.

SEVERAL plants of more than ordinary interest are figured and described in the last part of "Hooker's Icones Plantarum." *Thiseltonia*, a little plant with narrow leaves and small white flower-heads, belonging to the *Aster* family (Compositæ), and *Erichsenia*, a leguminous plant, with yellow, purple-striped flowers, are two new generic types discovered, in addition to several new species, by Mr. G. H. Thiselton-Dyer in West Australia. On plate 2785 is depicted the Chinese representative of the genus *Liriodendron*. Formerly it was regarded as a variety of the well-known Tulip Tree of eastern North America, which it very closely resembles. It seems extra

ordinary that these two species should be so widely separated geographically—one in eastern North America and the other in West China. In his "Sylva of North America," Sargent says that the genus was represented by several species in the Cretaceous age, which were widely distributed in North America and Europe. It continued to exist during the Tertiary period, with a species hardly different from *L. tulipifera*, extending over eastern North America and Europe as far south as Italy, until the advent of glacial ice destroyed it in Europe. It may be remarked that the American Tulip Tree furnishes the well-known whitewood, a light, easily worked wood often used in electric light installations. A remarkable variety of the Mahogany Tree is figured. The specimens shown were in the seedling state, and had grown only six to ten inches high when flowers were produced. Several plants, among them the common oak, sometimes behave in the same manner.

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One would scarcely expect to find the original description of a new plant in the "Geographical Journal." There is one, however, in the February number, where a remarkable new Alga, named *Clementsia*, in honour of the President of the Royal Geographical Society, is described by Mr. George Murray. An unusual amount of interest is connected with this tiny plant. It was the first new organism discovered on the Antarctic expedition sent out under the command of Captain Scott. Curiously, though a marine Alga, its nearest known allies are found in fresh water, and it reminds one, on looking at the plate furnished with the description, of a *Glæocapsa*. The material was collected by Mr. Murray himself off Brazil, lat. 7° – 12° S., long. 30° – 33° W. The name selected is unfortunate, as *Clementsia* is already pre-occupied, having been given by Dr. Rose, of the U.S. National Museum, to a Crassulaceous plant, formerly described as a *Sedum*. This *Clementsia* is commemorative of Professor F. E. Clements, of the University of Nebraska, and if a valid genus the name should remain, while the Alga will have to be provided with a new one.

* * *

Monsieur Pée-Laby, in the "Revue Générale de Botanique" for December, 1904, records the curious instance of a plant of the common passion-flower (*Passiflora cærulea*) having taken upon itself a semi-parisitic existence. A seed by chance was sown near a plant of *Euonymus japonicus*. On germinating apparently normal aërial parts were produced, but below the surface of the soil a union was effected between the passion-flower and the roots of the *Euonymus*, resembling that which takes place between a stock and scion in grafting. A number of roots developed on the passion-flower, so that it was not wholly dependent on the host-plant for its supply of food from the soil.

CHEMICAL.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

The Copper Treatment of Water.

DURING the last few months the new method of purifying drinking water by treatment with copper sulphate has been extensively adopted by large water companies in the United States, where previously some had had to discontinue the use of certain reservoirs owing to the growth of green algæ ("pond scum") rendering the water absolutely unfit for use. It has been proved that salts of copper possess extraordinary antiseptic powers, far exceeding those of either carbolic acid or formalin, and that the addition of as little as 1 part of copper sulphate to 5 million or even 50 million parts of the water is sufficient to destroy these low forms of plant life within three or four days. At the same time the growth of higher plants, such as watercress, is not injured, and the treatment is now being successfully applied to the watercress beds in the Southern States. In Professor Kraemer's opinion this difference in the behaviour of the higher plants and of algæ is due to the fact that the latter are unicellular, so that the entire functions of the organism are simultaneously affected, whereas in higher plants the copper can be distributed among the different cells and its toxic action diminished. Bacteria being also unicellular, it is not surprising that they, too, are destroyed by copper, though they offer greater resistance than the algæ. Thus Dr. Moore, of the U.S. Department of Agriculture, has found that the addition of 1 part of copper sulphate to 100,000 parts of water destroys the micro-organisms of typhoid and cholera within three or four hours. In one experiment a strip of copper placed in water containing some 4000 typhoid bacilli rendered the water sterile in four hours. As regards the influence of copper upon the human system, several leading American medical authorities have recorded their opinion that the traces of the metal in water treated by this method could not possibly be injurious. Copper is normally present in different kinds of food, and is eaten in large quantities in preserved peas, a tin of which contains many hundred times as much copper as is present in the treated water. Their general conclusion is that copper and its salts are much less poisonous than has hitherto been supposed, and that they are not cumulative in their action.

* * *

Buffalos' Milk.

The composition of buffalos' milk differs greatly from that of the cow, as has been shown by recent analyses made by Herr Windisch of the milk from three buffalo cows. It contained from 18 to 20 per cent. of solid substances, of which 7·9 to 9·2 per cent. was fat (cream) and 0·77 to 0·83 per cent. mineral salts. The milk of an average cow contains about 12½ per cent. of solid matter, of which about 4 per cent. is fat and about 0·8 per cent. mineral salts. Elephants' milk is still richer than that of the buffalo, for it contains about 30 per cent. of solid matter, including 20 per cent. of cream; while the richest of any known milk is that of the porpoise, with 60 per cent. of solid matter and 46 per cent. of cream. The milk sugar in buffalos' milk amounts to about 4½ per cent., as against about 4 per cent. in cows' milk, 20 per cent. in elephants' milk, and only 1½ per cent. in porpoises' milk.

* * *

Yellow Arsenic.

Messrs. Stock and Siebert have shown that when arsenic is heated in a tube from which the air has been exhausted, it condenses on the sides in a brilliant yellow coating. Arsenic is best known as a grey substance with a metallic lustre, and the yellow modification is slowly re-converted into this ordinary form when exposed to sunlight, and rapidly changed when heated in the air. This is an interesting illustration of what the chemists term "allotropic modifications." Chemically the substances are identical, like blacklead and the diamond; but they differ in physical properties, such as density, hardness, and melting point.

ORNITHOLOGICAL.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

Great Snipe in Shetland.

THE "Annals of Scottish Natural History" for January records the occurrence at Unst of a Great Snipe (*Gallinago major*) which was killed on Sept. 30, 1904, and weighed 7½ ozs. The Editor remarks that if this record is authentic then it makes the second record for the Shetlands. The doubt here expressed is begotten by the weight, which he seems to regard as somewhat light for this species, since the Common Snipe sometimes turns the scale at 7¾ ozs. Mr. J. E. Harting, however, in his valuable handbook, records the weight of the Solitary or Great Snipe as varying between 7½ and 10¼ ozs.

* * *

The Beak of the Hawfinch.

It may be of interest to the readers of this column to know that in examining some skulls of the Common Hawfinch a few days since I found two skulls still retaining the beak-sheath. On examining these I was surprised to find in the region of the gape, on the inner side of the lower jaw, two large rounded bosses of the size of peas, and having a finely striated surface. On the roof of the palate immediately above, I found an

oblong, cushion-like boss, similarly striated, and stretching across the jaw from one side of the tomium, or cutting edge of the beak, to the other.

These are evidently crushing pads, and recall the similarly shaped teeth of certain elasmobranch fishes, and of *Cyamodus* among the Reptiles. So far I have not been able to find any reference to, or description of, these pads.

* * *

The Emperor Penguin.

Dr. E. A. Wilson, the Assistant-Surgeon and Naturalist of the "Discovery" expedition, gave a most interesting account of the life-history of the Emperor Penguin at the Royal Institution on Friday, January 27.

Hitherto nothing was known of the breeding habits of the Emperor Penguin (*Aptenodytes forsteri*), and consequently all will appreciate the immense amount of trouble and hardship that had to be encountered in order to track this bird to its fastnesses.

It has been stated more than once that the penguins lay but one egg, and carry this in a pouch! Dr. Wilson confirmed the opinions of those who had expressed grave doubts as to the probability of this story, and showed, by means of pictures thrown upon a screen, exactly how the duties of incubation were performed. In the case of the Emperor Penguin, the egg, and, later, the chick, is supported on the upper surface of the feet and overlapped by the feathers of the abdomen.

The coloration of the young is remarkable, inasmuch as it differs from all other penguins. The upper surface is almost white, the under surface somewhat darker, while the head is velvety black, relieved by a conspicuous white face.

The position assumed during sleep by these birds goes far to show, Dr. Wilson remarked, that the penguins once possessed the power of flight, since they still thrust the beak down between the now flipper-like wing and the body, though from the peculiarly close-fitting plumage characteristic of these birds, the comfort to be derived from such an attitude at the present day must be a minus quantity!

Why is it, the lecturer asked, that these birds choose the coldest part of the Antarctic winter for breeding?

Two "rookeries" were visited during the expedition; one at Cape Crozier, and one at King Edward's Land. The latter was by far the larger of the two, and, apparently, the more favourable as a nursery; for at Cape Crozier he estimated that the mortality among the chicks reached the amazing rate of 77 per cent.!

Save at sea, these birds appear to have no enemies, but the hunt for food is attended with many perils, the leopard seal and the killer whale displaying a great fondness for penguin meat.

Dr. Wilson is preparing a detailed account of his observations for the Royal Society, and on this account we forbear from giving further details of his discourse.

ZOOLOGICAL.

By R. LYDEKKER.

The Speed of Animals.

MUCH interest attaches to a note by Mr. Thompson Seton on the speed of certain animals which recently appeared in the *Field*. The observations were taken by the author himself with a stop-watch, and record the best speed for a mile of the various species. Although the best record for a race-horse is at the rate of nearly 35 miles an hour, Mr. Seton gives the first place to the greyhound, with a rate of 34 miles an hour. Then follow the racehorse with 32, the American prong-horn antelope with 30, the American "jack-rabbit" with 28, the common fox with 26, the coyote or prairie-wolf with 24, the foxhound with 22, and the American grey wolf with 20. A man's best speed works out at the poor figure of 14 miles an hour, while an ordinary runner who can do his mile in five minutes moves only at the rate of 12 miles in the hour. In commenting on this note, a second writer considers that the speed of the horse is under-estimated.

The Stoats of Jura and Islay.

To the *Annals of Scottish Natural History* for October Captain Barrett-Hamilton contributes some notes on the stoats of the islands of Jura and Islay. From both islands the stoats, as contrasted with those of the mainland, are characterised by their inferior size, relatively larger tail and ears, and certain peculiarities in the skull. These features are most marked in the Jura examples, those from Islay being somewhat larger. The occurrence of a stunted race of stoats in these islands with relatively large ears might, according to the author, be readily accounted for if food were scarce and good hearing an important aid in the capture of scanty prey. The increased length of tail is, however, less easy to explain. Although Captain Hamilton believes these stoats to indicate a distinct local race of the species, he has not yet proposed a special name for them.

* * *

The Musk-Ox in England.

Among the numerous species of large mammals whose bones are to be met with in a sub-fossilized condition in the gravels and other superficial deposits of this country is the musk-ox (*Ovibos moschatus*), an animal now confined to Greenland and the barren grounds of Arctic America, but which had a wide range in the northern part of the Old World during the Pleistocene Age. The musk-ox was first added to the extinct British fauna in 1875 by Messrs. J. Lubbock (now Lord Avebury) and C. Kingsley, on the evidence of a portion of a skull dug up in a gravel-pit near Maidenhead; and only six or seven other occurrences of remains of the same animal from British formations have been subsequently recorded. Recently, however, Dr. C. W. Andrews exhibited before the Zoological Society the hinder part of the skull of an old bull musk-ox, showing the characteristic bases of the horn-cores, which had been obtained from a gravel-bed at Frampton-on-Severn, Gloucestershire; and he also referred to a few bones of the same species, comprising the second vertebra of the neck and portions of the radius and femur, from the brick-earths of Plumstead. The remains of the Pleistocene musk-ox indicate a larger animal than its living representative, although, in the opinion of Dr. Andrews, the difference is not sufficiently great to render it advisable to regard the former as a race apart. If this opinion should be reversed, the name *Ovibos moschatus pallasi* is available for the Pleistocene animal.

* * *

A White American Bear.

Hitherto the polar bear (*Ursus maritimus*), which differs very markedly from its kindred in the characters of its skull and teeth, has been supposed to be the only pure white member of the group. Mr. W. T. Hornaday, in the Report of the New York Zoological Society, has, however, recently described four skins, together with portions of the skull, from British Columbia, which indicate a bear nearly related to the common American black bear (*Ursus americanus*), but creamy-white in colour. As this small white bear seems to be fairly common in one part of British Columbia, Mr. Hornaday (who cannot believe that it is a mere family of albinoes) regards it as a new species, with the name of *Ursus kermodei*.

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Papers Read.

In our last month's issue the name of Mr. H. D. Imms is misprinted Jenner, the writer not having had an opportunity of revising the proofs. At the meeting of the Zoological Society on January 17, in addition to the papers recorded in the issue just referred to, Dr. C. W. Andrews, exhibited and described the fossil musk-ox skull from Gloucestershire, mentioned in an earlier paragraph; while Mr. H. E. Dresser brought to the notice of the fellows three new species of birds obtained during the Lhasa expedition. The papers read at the meeting of February 7, included one by Mr. N. Annandale, on abnormal tadpoles from India; a second by Mr. G. A. Boulenger, on East African fishes; a third by Dr. R. Broom, on some points in the anatomy of the extinct reptile *Diademodon*; and a fourth by Mr. G. L. Bates, on the mammals of the Southern Cameroons and the Benito district. Mr. Bethune-Baker also described a collection of Heterocerca from Fiji, Mr. Beddard discussed the arteries in the brains of birds, while Mr. Yearsley discoursed on the function of the antennæ of insects. At the meeting of the Linnean Society held on February 2, a paper by Dr. H. J. Hansen, was read on European *Cirolanina* (Isopoda.)

XUM

REVIEWS OF BOOKS.

A Popular Guide to the Heavens, by Sir Robert Stawell Ball, LL.D., F.R.S. (G. Philip and Son; price 15s. net). This book, of a handy size (7 inches by 8) and handsomely bound, consists chiefly of a number of charts, diagrams, and photographs ranging through all branches of astronomy, accompanied by some 80 pages of explanatory matter. It forms what may be called a *réchauffé* of a former work of Sir Robert Ball's which has long been out of print, but has been so greatly amended and added to as to form a new book. The author, in the preface, describes the work involved in the preparation as having been "very onerous," but records his indebtedness to Mr. Hinks for selecting the new plates, as well as for the preparation of the text which accompanies them. Among the more novel features are a series of 12 tinted illustrations of the moon in different phases, each being accompanied by its own full-page key-map. These, rather coarsely drawn, seem to us hardly worth the space bestowed upon them, especially considering that there are besides a complete chart of the moon in four parts, showing all the conspicuous features, as well as three fine photographs giving a good idea of the appearance of the lunar surface when viewed through a powerful telescope. The 12 monthly maps of the stars may also seem somewhat superfluous, being on so small a scale (4½ inches diameter) and, of course, containing repetitions of most of the constellations, while they are followed by 20 sectional star maps on a larger scale, as well as two key-maps. These sectional maps are on the conical projection as in Argelander's Durchmusterung Atlas, the stars being printed in black on a light blue ground, and are reprints of those which appeared in the older atlas. The book will form a very complete and reliable handbook for all students of astronomy.

Light Energy; its Physics, Physiological Action, and Therapeutics. By Margaret A. Cleaves, M.D. (London: Rebman and Co.; price, 21s. net).—Dr. Margaret Cleaves divides her book rightly into two portions. In the first of them she assembles the known laws and theories of light energy from the aspect of physics; in the second she subjects the whole number of authenticated cases of light therapy to a critical examination and analysis. To the first part of her task she brings an excellent appreciation of essential points and an admirably clear method of exposition; and for the consideration of the medical and surgical aspects of "the light cure," she comes equipped with eleven years of practical experiment and investigation of actual cases. The opinions formulated by other investigators have been carefully analyzed, and the conclusions drawn therefrom submitted to searching criticism; and no case and no evidence are admitted to her pages without having shown the clearest right to be there on authenticated evidence. The result of this inclusive but fastidious method has been to present in one volume the whole of the present accredited facts concerning light therapy, with an accompaniment of illuminating exposition and suggestion. The various forms of light treatment—sun baths, arc light, incandescent light—are considered and described; and the relative efficiency of the large lamps, such as were used by Finsen, and the smaller lamps, such as have in many hospitals (the London Hospital, for example) supplemented or replaced the larger ones, is discussed. According to Miss Cleaves, the great advantage of a lamp of high power, such as the Finsen arc lamp, is that not only does the patient receive the short high frequency rays of great chemical activity, but also the waves of greater length with greater penetrability. The smaller lamps are taking in the longer waves. The applications of coloured lights and the rays at the invisible end of the spectrum are discussed, and the rays proceeding from radium and thorium, "the poor relation of radium," are considered from the therapeutic point of view. The value of the effects of radio-active emanations as demonstrated by actual cases is examined and discussed. The last two chapters deal with the methods of sensitising tissues to the action of light, in some cases by the ejection of fluorescent substances, and with the destructive effect of light in some conditions of the skin or of the organism. Dr. Cleaves' compilation is an extremely valuable one, with every recommendation of thoroughness, clearness, and the properly judicial attitude.

Three volumes are before us of the "**Shilling Scientific Series**" (T. C. & E. C. Jack), 1s. each. To designate these as scientific works is perhaps somewhat a misnomer, comprising as they do but elementary and "popular" accounts of certain subjects which may have some scientific connection. "**Balloons, Airships, and Flying Machines,**" by Miss Gertrude Bacon, is the first of the series. This is a simple but accurate *résumé* of the history of Aëronautics. It contains a number of very indifferent illustrations, and a few novel expressions (one, for instance, which we would not however pronounce to be incorrect, is "Mr. Edward Spencer, grandfather of the present well-known firm of aëronauts"). The book bears no date, which is always apt to be misleading, but it is presumably only just published, and might therefore have been brought more up-to-date, for there is but the briefest reference to the Lebaudy airship, which has been so much to the fore of late. An index would certainly enhance the value of the book. But these are all the faults we can find, and anyone requiring a short but complete and reliable account of what has been accomplished in navigating the air can nowhere find a better guide than this. The next volume of the series is "**Motors and Motoring,**" a very practical little handbook by Professor H. J. Spooner, essentially, as stated, for novices. It is most satisfactory to find such an abundance of good information compressed into so small a space. The general principles of motors are fully described without digressing on the many varieties of detail now to be met with in the various makes of car. There are many clear diagrammatic figures, which render the description of the mechanism quite comprehensible to the learner. Explanatory annotations are a feature of the book, which add to the clearness, while not introducing too long a description of any one detail. The third volume is "**Radium Explained,**" by Dr. W. Hampson, and here we are led more into the realms of true science, for not only is there a wonderfully complete account of what is known of Radium, but many other side issues, such as the Structure of Matter, Ionization, Theories of Gravitation, and Stellar Systems are gone into. This is all explained in simple language, and the little work, by so good an authority, should prove most useful to those wishing information on this subject.

The Zeiss Works and the Carl-Zeiss Stiftung, by Felix Auerbach, translated from the German by S. F. Paul and Fred. J. Cheshire (Marshall, Brookes and Co.), 2s. 6d., is an interesting account of this well-known establishment. "It is by no means as well known as it ought to be that the Jena enterprise is distinguished not only by the excellence and variety of the instruments turned out by its workshops, but even more by the unique character of its organisation and the conduct of its business." This little book gives a very complete history and description of the whole affair, and appears just at the time when we read of the unfortunate loss of one of the principal actors, Professor Abbe. After briefly noticing the early history of optics, the author tells of the new era of microscope construction, the formation of images of non-luminous objects, the new glass, and the Photographic, Astronomical, and Measuring-Instrument Departments of the works. The "Stiftung" or "Trust" is then described. This was founded by Abbe, who had eventually, in 1888, succeeded Carl Zeiss as the sole proprietor of this great works. In his unselfish generosity he considered that he had no claim to be considered as a capitalist who had risked his money in founding the concern, and accordingly handed over the administration of the business to the "Stiftung" or co-operation of the officials and workmen of the works as well as the University and community of Jena. The employees are thus remunerated under two heads, a fixed wage and a result of the year's trading.

Botany.—"Trees" (Cambridge, at the University Press). Volume II. of Professor Marshall Ward's admirable "Handbook of Forest-Botany for the Woodland and the Laboratory" deals with leaves. It treats of their external features, as well as of their anatomical and microscopic structure, and the metamorphoses which they undergo. Professor Marshall Ward lays great stress on the educational value to the student of the ability to draw and describe accurately the peculiarities of leaves, as a thorough comprehension of the conformation and adaptations of the leaf is "the key to the morphology of the higher plants." The language used is never unnecessarily technical, and much value is added to the work for students by the numerous and excellent illustrations.

X-Rays: Their Employment in Cancer and other Diseases. By Richard J. Cowen (London, Henry Glaisher; price, 2s. 6d.).—In Dr. Cleaves' book the Roentgen ray has not been considered, although it properly belongs to a consideration of light energy, because in the author's opinion the subject has been exhaustively treated by other writers. Mr. Cowen's book on the X-rays is not an exhaustive treatment; and makes no effort to summarize either results or conclusions. It only aims at selecting such details of X-ray treatment as may be of assistance to those practitioners who desire to make use of it; and to give hints concerning the use of apparatus and the methods and times for exposures. Incidentally, the book may be of service in disclosing to the general reader the probable limits of usefulness in this method of treatment and in dissipating some of the unfounded expectations of cures arising from it.

Practical Exercises in Chemical Physiology and Histology. Arranged by H. B. Lacey and C. A. Pannett (Cambridge: Heffer and Sons. London: Simpkin and Marshall).—In this capital little book of instruction for practical work, in which the experiments to be made are annotated for the student's benefit with the results to be looked for, Mr. Lacey and Mr. Pannett have hit the best road, if not the royal road, to learning. The description of the chemical compound to be analysed heads each exercise like the statement of a problem or a theorem; its methods of analysis follow like a problem; and the statement of the results to be expected from chemical treatment or analysis give the key to the problem. The exercises have been arranged on a course which has been found practicable in the senior classes of day science schools and in evening classes, and which will be found to meet the requirements of students preparing for physiology examinations—Stages I., II., and III., and Honours of the Science Department of the Board of Education. Some of the results obtained from the analysis of popular meat extracts have an interest for a larger section of the general public than is comprised among science students.

The Geographical Journal, Vol. XXIV., July to December, 1904 (Royal Geographical Society).—This is an exceptionally interesting volume, containing as it does the Presidential Address for 1904, the Summary of Proceedings of the National Antarctic Expedition by Captain Scott (forwarded from New Zealand), account of the Swedish Antarctic Expedition by Dr. Nordenskiold, account of the German Antarctic Expedition, and finally an account of the Antarctic Meeting at the Albert Hall and presentation of medals to Captain Scott. So that, accompanied by a number of good maps, there is a very complete record of what has been done in antarctic exploration in recent years. Besides this there are several specially notable papers, such as Major Powell-Cotton's narrative of his journey through Northern Uganda, the Rev. A. B. Fisher's account of Western Uganda, and the scientific results of Dr. Sven Hedin's Last Journey. There is also much in this volume about the Bathymetrical Survey of the Fresh Water Lochs of Scotland, and the usual interesting assortment of Geographical records, with many illustrations and maps.

Wellcome's Photographic Exposure Record for 1905 (Burroughs Wellcome & Co.), 1s. and 1s. 6d.—This neatly-got-up little pocket-book has several new features this year, amongst others being that the monthly light tables are so arranged that they may be torn out as done with each month, and a number of blank ruled pages form the Exposure record. The book is replete with information on the development, toning, intensification, exposure, &c., of photographic plates, and contains a diary, memoranda, and many useful tables, ending up with a revolving exposure calculator.

The same firm (Messrs. Burroughs and Wellcome) send us some interesting pamphlets on their exhibits at the St. Louis Exposition, which indicate in a concise manner the size and completeness of their Physiological and Chemical Research Laboratories.

We have received for review three new volumes of "The Model Engineer Series" (Percival Marshall and Co.; price 6d. net). **Model Steam Turbines,** by Mr. H. H. Harrison, lays down the principles on which these engines may be designed. It is clearly written and fully illustrated. **"Small Electrical Measuring Instruments,** published anonymously, is designed for the use of those who are engaged in the construction of small-power dynamos or electric motors, &c., and who want to make simple tests and measurements when building and using them. The explanations given are of a simple rather than an advanced nature. **The Beginner's Guide to the Lathe,** by Percival Marshall, A.I.Mech.E., is addressed, as its title suggests, to novices in the use of that fascinating instrument. It is well designed to suit its purpose, and the appliances suggested are of a simple and inexpensive kind.

How a Steam Engine Works, by W. E. M. Curnock (Dawbarn and Ward), 6d., is a practical and handy little guide for those wishing to learn the principles and practice of the steam engine, illustrated with clear diagrams. **How to Read a Workshop Drawing,** by W. Longland is another little book of the same series, which clearly explains all the different "conventionalities" of machine designs and drawings, and is well worth perusal by those who have not been instructed in such matters.

The copyright of that most useful and popular handbook, "Half Hours with the Microscope," by Dr. Edwin Lankester, formerly published by Messrs. W. H. Allen and Co., has been acquired by Messrs. C. Arthur Pearson, Limited, who have also purchased the companion volume by Thomas Davies, on the "Preparation and Mounting of Microscopic Objects." The latter has been out of print for some time, but a new and cheaper edition will be published very shortly.

Rendering Celluloid Incombustible.

In order to overcome the undesirable quality of celluloid to gnite, a French chemist has adopted the following method: An ether-alcohol solution of celluloid is made; then an ether-alcohol solution of ferric perchloride. The two solutions are mixed, and a clear, syrupy liquid is obtained, of yellow colour, yielding no precipitates. The liquid is poured into a suitable vessel and is left for spontaneous evaporation, and a substance of shell-colour is produced, which, after washing and drying, gives the desired result. The celluloid thus treated loses none of its properties of pliability and transparency, and is not only uninflammable, but is also incombustible.

Another method by which the celluloid may be rendered uninflammable, based on the same principle, consists in mixing bromide of camphor with cotton powder, adding castor oil to soften the substance so that it may be less brittle. This product, though more easily prepared, is, however, not incombustible like the former preparation.

"Solidified Raindrops."

Mr. Wilson A. Bentley, writing in the *Monthly Weather Review* (October), gives an account of studies of the comparative sizes of raindrops extending from 1899 up to the present time. The method of comparison consisted in letting the rain fall into a dish containing fine flour, and the size of the dough pellets formed afforded a measure of the size of the drops producing them. For small drops, the pellet was found by laboratory experiments to be almost exactly the size of the drops, but with large drops a certain flattening out took place. The method is very simple, and enables the features of different showers of rain to be compared at a glance, and the variations in the size of the drops at the beginning, middle, and end of a shower recorded. Presumably the wind must not be so high as to blow all the flour away. It may be suggested that people who have time to spare and wish to devote their attention to some interesting and scientific pursuit requiring little trouble, might do worse than form a collection of "solidified raindrops," and if this were done systematically by a large number of observers scattered over the country, the observations could not fail to afford a share of useful meteorological information.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, F.R.M.S.

Fibrous Constituents of Paper.

(*Continued from Page* 42.)

THE question of indentification is much simplified if we consider first what are the fibres we shall have to deal with. Many fibres have been suggested for use in paper-making, but in most cases either the supply has proved insufficient, or the cost of transport has been prohibitive, or the "yield" of fibre after treatment has proved to be not enough to repay the cost of such treatment and of the transport. Therefore the fibres in general use are comparatively few, which much simplifies the matter. They are principally as follows:—For white papers: linen, cotton, esparto grass, straw, and chemical or mechanical wood-pulp, and more rarely hemp and manilla hemp; for coarse papers: hemp, manilla hemp, jute, straw, and chemical or mechanical wood-pulp. It will be observed that with the exception of esparto, straw, and wood-pulp, the paper-maker gets his materials second-hand as rags, sacking, ropes, or twines, when all other use for them has gone.

To show that the matter has more than a merely academic interest, I may mention that I have several times had papers submitted to me for microscopical examination and analysis when there was a dispute between buyer and seller as to the material of which the paper was made, and where one party threatened legal proceedings against the other. The papers were sent to me simply marked A, B, C, etc., and I was asked, for instance, to say whether these papers were "all rag" or not. It is satisfactory to know that in each case I was subsequently informed that my statement had been accepted by both parties as correct, and an agreement arrived at, which may be taken as showing the value and accuracy of this method of examination.

For the identification of these respective fibres a knowledge of botany is not requisite, though it may be useful. The fibres have been so mangled and torn and twisted in the process of pulping—"beaten" is the technical term for it, just as certain Eastern nations still beat out the fibres with a mallet upon a stone—that their appearance has become much altered. But the fibres must be isolated and must be freed from all sizing and colouring matters. This is easily done by boiling in dilute caustic soda solution—one or two per cent.—for a short time, then placing on a fine sieve and washing several times with warm water, after which they may be shaken up in a bottle with some clean angular pebbles to further disintegrate them, though I have generally found rubbing with the finger on the sieve quite sufficient. Only a very small piece of paper is required, and of this only a very tiny amount of pulp is transferred to an ordinary microscope slide. This pulp must now be carefully teased out with needles so that each fibre stands free from overlying or entangling fibres, and no tufts or opaque masses are left.

The identification of the respective fibres depends on three things, none of which, in my opinion, is it safe to trust to alone: the structural appearance of each fibre, its colour reaction with certain reagents, and its behaviour with polarized light. It is fortunate that all these can be carried on without their interfering with each other.

The microscope must be provided with an analyser and polarizer, and it is of great service if the latter is fitted with a screw into which the optical part of an ordinary condenser can be placed so as to obviate to some extent the great loss of light due to polarization. The objectives suitable are an inch, or, preferably, a half-inch, and a one-sixth or one-quarter inch.

The reagents suggested have been many, of which iodine used with dilute sulphuric acid has, perhaps, been most serviceable in the past, but the reagent most used now is known as chlor-zinc iodine, and is made as follows, according to Stasburger's formula. Zinc is dissolved in pure hydro-chloric acid, and the solution evaporated to the consistence of strong sulphuric acid (metallic zinc being kept in it during the process). In this is dissolved as much potassium iodide as it will take up, and, finally, as much metallic iodine as it will dissolve. The reagent acts much more quickly in water or glycerine preparations than in alcohol.

The fibres having been teased out upon a slide as already mentioned, are freed as far as possible from water by being pressed with a piece of filter paper, a drop or two of the reagent is added, and a cover-glass placed over the preparation. Any excess of reagent may be taken up with filter paper. The reaction is almost immediate. The cover-glass is advisable not only for convenience in examination but to reduce the amount of reagent so that the resulting colours may not be masked, and also because iodine volatilises and the colours are not permanent.

(*To be continued.*)

Royal Microscopical Society.

At the annual meeting held on January 18 at 20, Hanover Square (the President, Dr. Dukinfield H. Scott, F.R.S., in the chair), the President alluded to the death of Professor Abbe, of Jena, who had been an honorary Fellow of the Society since 1878, and said that there was perhaps no one whose loss would be more felt by a Society such as their own. Professor Abbe's name was familiar to everyone acquainted with the microscope, and even those who were not able to follow the details of his work would recognise the great services he had rendered to optical science. The Secretary then read the annual report, and the Treasurer read his annual statement of accounts and balance-sheet. The result of the ballot for the new Council was announced, the President being re-elected for another year, and all the other Fellows proposed for election on the Council being also elected. The President then delivered his Annual Address, the subject being an inquiry as to "What were the Carboniferous Ferns?" At the commencement of the address the President referred to the recent death of Professor B. Renault, the well-known Paleo-botanist, who had been elected an honorary Fellow of the Society as

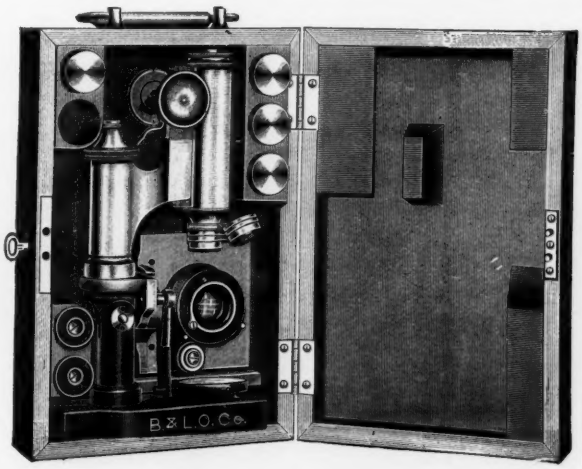
recently as June last. The address was illustrated by many lantern slides and by sections of fossils from the coal-measures shown on the screen, whilst Professor F. W. Oliver kindly lent a number of specimens, and Mr. Smedly, F.L.S., exhibited some beautiful large scale models.

The Quekett Microscopical Club.

The 419th ordinary meeting of the Club was held on January 20 at 20, Hanover Square, the President, Dr. E. J. Spitta, V.P.R.A.S., in the chair. The death of Professor Ernst Abbe, who had been an honorary member of the Club since 1879, was announced, and a motion recording the Club's appreciation of his services to microscopy and sympathising with his family in their loss was unanimously adopted. Mr. C. F. Rousselet, F.R.M.S., then gave a detailed description of his well-known compressor, describing the various features which he had considered essential to the object which he had in view when designing it, viz., the examination of the smallest living rotifers under high power objectives and with critical illumination from modern wide-angled condensers. The model was completed in 1893, and had been in use ever since with such success that he had found no openings for alteration or improvement. The various so-called "Improved Rousselet Compressors" which were on the market were, in his opinion, anything but improvements upon the original model, and he strongly disapproved of them. The Hon. Secretary then read a note by Mr. A. E. Merlin, F.R.M.S., "On the cut suctorial tubes of the Drone Fly's proboscis as a suggested test object for medium powers." Mr. Merlin pointed out the difficulties attaching to the use of the Blow Fly proboscis as a test for the $\frac{1}{4}$" or $\frac{1}{6}$" objective, in the hands of a tyro. Formerly the Podura scale was the most satisfactory test for such powers, but it was difficult nowadays to obtain a slide. The Drone Fly's proboscis was in structure similar to the Blow Fly's, but the detail was finer.

Bausch and Lomb's New Portable Microscope.

Messrs. A. E. Staley and Co. have sent me for inspection their new "B.B.P." portable microscope. This is a full-size microscope of the Continental type, with large vulcanite stage, sub-stage adjustable by spiral rack and pinion carrying condenser and iris diaphragm, coarse and fine adjustments, draw-tube, &c. The stage is, however, mounted on an axis, so that it, with its condenser in place, can be swung into a vertical position, a clamp fixing it when in the horizontal position, whilst the base folds together. The microscope, with objectives and eyepieces, goes into a case measuring $11\frac{3}{4} \times 8 \times 4\frac{1}{2}$ inches. This is, of course, not one of the most compact microscopes, the idea being to retain all the advantages of the full-size microscope and to add portability. The case is, therefore, too heavy for carrying any great distance. The instrument is beautifully finished, as are all microscopes made by the Bausch and Lomb Optical Company; the objectives are excellent, and the case is exceptionally handsome. The fine adjustment was, however, somewhat coarse in movement, whilst in the instrument sent me the condenser did not quite focus. The tube was of the Continental size and length, and the objectives were marked with tube-length, numerical aperture, and power, which I wish one could see on all objectives. There was also an extra diaphragm immediately beneath the stage; but this is, I always think, an unnecessary luxury.



The Postal Microscopical Society.

A perusal of the Annual Report of this Society makes one feel that its limited membership can only be due to the fact that its very existence must be unknown to the vast majority of those amateur microscopists to whom it specially appeals. The Society was founded in 1873 by the late Alfred Allen, of Bath, and its mode of working is briefly as follows: Each member contributes a dozen slides—his own make if possible; if not, good purchased ones. To these he adds a small notebook and notes on the various slides. The notes may or may not be entirely original, but they are explanatory, and there may even be one or two drawings illustrative of certain points. If the slides are his own mounting, he adds a few notes as to how he mounted them, and he may also ask for information or help on various matters from other members who will see his slides and notes. The box of slides goes in to the Secretary, who adds four slides from the Society's cabinet, making 16 in all. The members are divided up into "circuits" of seven members each, and the boxes with their notes pass on from member to member at intervals of six days, each member adding a few notes to the notebook as he passes it on. When the box has made its complete round of all the "circuits" it returns to its owner, who keeps it, the notebook, and the four additional slides, he himself having meanwhile, of course, been the due recipient of all the other boxes in due turn. This is the ideal arrangement, but it is departed from when members fail to send on their boxes according to the rules, and fail to add notes and comments other than expressions of regret for their remissness. It will be seen that the whole scheme is simple in the extreme, and it gives to every member an opportunity of seeing and studying at leisure a large number of slides on very varied subjects, of interchanging views with brother or sister enthusiasts, and of getting assistance on thorny points. Such a Society will, of course, appeal almost entirely to amateur microscopists; but to them it should be of real service, and I would suggest that any of my readers who are interested should write to the Hon. Secretary, Miss Florence Phillips, 3, Green Lawn, Rock Ferry, Cheshire, for further particulars. The subscription is five shillings per annum, with a small entrance fee.

[Communications and enquiries on Microscopical matters are invited, and should be addressed to F. Shillington Scales, "Jersey," St., Barnabas Road, Cambridge.]

XUM

The Face of the Sky for March.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 6.49, and sets at 5.37; on the 31st he rises at 5.42, and sets at 6.28. The Sun enters the sign of Aries at 7 a.m. on the 21st, when Spring commences.

An annular eclipse of the Sun takes place on the 6th; it is invisible in this country, but visible in Australia.

The solar disc has been well marked with large sunspots, whilst prominences have been large and active.

For physical observations of the Sun the following data may be used:—

Date.	Axis inclined from N. point.	Equator N. of Centre of disc.
Mar. 2 ..	21° 59′ W.	7° 15′
,, 12 ..	24° 8′ W.	7° 12′
,, 22 ..	25° 36′ W.	6° 55′

The Zodiacal light should be looked for in the west for a few hours after sunset.

THE MOON:—

Date.	Phases.	H. M.
Mar. 6 ..	● New Moon	5 19 a.m.
,, 14 ..	☽ First Quarter	9 0 a.m.
,, 21 ..	○ Full Moon	4 56 a.m.
,, 27 ..	☾ Last Quarter	9 35 p.m.
Mar. 8 ..	Apogee	6 54 a.m.
,, 21 ..	Perigee	10 48 a.m.

OCCULTATIONS.—The only bright stars occulted during convenient hours are:—

γ Tauri (mag. 3·9) at 10.11 p.m. on the 12th.
β Virginis (mag. 3·8) at 9.2 p.m. on the 20th.

THE PLANETS.—Mercury is in superior conjunction with the Sun on the 10th, after which he is an evening star, setting about 7.30 p.m. on the 23rd; he should be looked for in the west towards the end of the month, as he is approaching a favourable elongation.

Venus is the most conspicuous object in the evening sky, being at *greatest brilliancy* on the 21st, when the planet sets about 10.20 p.m. Throughout the month the planet is well placed for observation, and is best scrutinized before darkness sets in, as outstanding chromatic aberration of the object glass is not so obtrusive. From the point of maximum brilliancy the planet appears to move rapidly towards the Sun, inferior conjunction taking place about a month later. About the middle of the month the phase of the planet is crescent, 0·33 of the disc being illuminated, the diameter being 35″. On the evening of the 9th, the Moon, Jupiter, and Venus all appear in close proximity to each other.

Mars is situated in Libra, and rises about 11.20 p.m. near the middle of the month.

Vesta the brightest of the minor planets, is in opposition to the sun on the 24th, when its magnitude is 6·3. The asteroid is describing a retrograde path near the star ρ Virginis.

Jupiter is getting more to the west and is only available for observation for a few hours after sunset, also, on account of increasing distance from the earth, his lustre is diminishing and he is altogether outrivalled in brilliancy by Venus, which appears in the same region of the sky.

At the beginning of the month the planet sets at 10 p.m., when the equatorial diameter is 35″·8, and on the 31st at 8.47 p.m., his apparent equatorial diameter then being 34″·0.

The following table gives the satellite phenomena visible in this country.

Date.	Satellite.	Phenomenon.	P.M.'s. H. M.	Date.	Satellite.	Phenomenon.	P.M.'s. H. M.	Date.	Satellite.	Phenomenon.	P.M.'s. H. M.
Mr.				Mar.				Mar.			
1	I. Tr. E.		7 15	8	I. Tr. I.		7 2	21	II. Oc. D.		7 10
	I. Sh. E.		8 15		I. Sh. I.		7 58	24	I. Tr. E.		7 50
5	II. Tr. I.		7 17	9	I. Ec. R.		7 28	30	II. Tr. E.		7 41
8	III. Oc. R.		7 2	14	II. Ec. R.		8 31	31	I. Tr. I.		7 39

"Oc. D." denotes the disappearance of the Satellite behind the disc, and 'Oc. R." its re-appearance; "Tr. I." the ingress of a transit across the disc, and "Tr. E." its egress; "Sh. I." the ingress of a transit of the shadow across the disc, and "Sh. E." its egress.

Saturn is a morning star, rising about 5.30 a.m. near the middle of the month.

Uranus also does not rise till early morning throughout the month.

Neptune is on the meridian about 7.45 p.m. on the 1st, and at 5.50 p.m. on the 31st; he is in quadrature with the Sun on the 26th. The planet is near μ Geminorum, and can readily be found by reference to that star.

	Right Ascension.	Declination.
Neptune (Mar. 15).	$6^h\ 23^m\ 14^s$	N. 22° 21′ 8″
μ Geminorum . .	$6^h\ 17^m\ 13^s$	N. 22° 33′ 38″

METEOR SHOWERS:—

Date.	Radiant. R.A.	Radiant. Dec.	Near to	Characteristics.
	h. m.			
Mar. 1–4	11 4	+ 4°	τ Leonis	Slow; bright.
,, 14	16 40	+ 54°	μ Draconis	Swift
,, 24	10 44	+ 58°	β Ursæ Maj.	Swift
,, 28	17 32	+ 62°	ζ Draconis	Rather swift.

Minima of Algol occur on the 18th at 0.34 a.m., and on the 20th at 9.23 a.m.

Double Stars.—γ Leonis, X.^{h} 14^m, N. 20° 22′, mags. 2, 4; separation 3″·8. In steady air, the prime requisite for double star observations, this double may be well seen in a 3-in. telescope with an eyepiece magnifying about 30 to the inch of aperture, but on most nights one with a power of 40 is better.

The brighter component is of a bright orange tint, whilst the fainter is more yellow.

ι Leonis, XI.^{h} 19^m, N. 11° 5′, mags. 4½, 7½; separation 2″·2. A pretty double of different coloured stars, the brighter being yellow, the other blue. This object requires a favourable night and a fairly high power on small telescopes.

α Leonis (*Regulus*) has a small attendant about 180″ distant, magnitude 8·5, and easily seen in a 3-inch telescope.

α Canum Venat. (*Cor Caroli*), XII.^{h} 52^m, N. 38° 50′, mags. 2·5, 6·5, separation 20″; easy double, can be seen with moderately low powers, even in 2-in. telescopes.

CLUSTER.—M 44, the Præsepe in Cancer, visible to the naked eye as a nebulous patch, best seen and easily resolvable with a pair of opera or field glasses. On account of the scattered nature of the group the cluster effect is lost when observed with a telescope unless very low powers be employed. Situated about midway and a little to the west of the line joining α and δ Cancri.